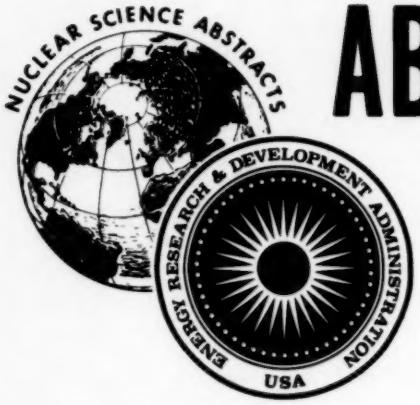
NUCLEAR SCIENCE ABSTRACTS



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FINAL VOLUME
See Notice Inside

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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Volume 33, Number 3, February 15, 1976

NUCLEAR SCIENCE ABSTRACTS

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Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

NOTICE

The publication of *Nuclear Science Abstracts* is planned to be discontinued after Vol. 33, No. 12, dated June 30, 1976. *Atomindex*, published by the International Atomic Energy Agency and a product of the International Nuclear Information System (INIS), will provide essentially identical literature coverage, subject scope, abstracting and indexing with that of *NSA*. For all practical purposes the two journals are identical. The Energy Research and Development Administration, formerly the Atomic Energy Commission, has supported the concept and development of INIS for several years. At this time, it is quite apparent that the decentralized scanning, abstracting and indexing on a country-by-country basis is reliable and successful. Consequently, it is no longer necessary for the United States to bear the entire burden of publishing an abstract journal covering the world's nuclear literature. ERDA will continue to provide coverage of U. S. nuclear literature to INIS.

Atomindex is available on a subscription basis from UNIPUB, P. O. Box 433, Murray Hill Station, New York, New York 10016, for $150 per year including cumulative indexes. ($100 per year without cumulative indexes.)

ERDA's new journal, *ERDA Research Abstracts* (*ERA*), will contain abstracts and indexes to all literature of ERDA origin as well as nonnuclear energy information generated by foreign countries with which ERDA has agreements for cooperation. *ERA* is available to government agencies on the same basis as *NSA* and on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information.

The public may obtain *ERA* from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The annual subscription rate for the 12 regular issues including an annual cumulative index is $119 for domestic subscribers, and $148.75 for foreign subscribers. Individual issues will be priced at $7.40 domestic, and $9.25 foreign. Separate annual index cumulations will cost $30.50 domestic, and $38.15 foreign.

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Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SOLDAN, D.W., Shipping container for a bottle of radioactive material, 32:20442
SOLDAT, J.K., Dosimetry of the radioactive noble gases, 32:19918 (BNWL-SA-4813)
SOLOMAKHA, D.A., Measurement of the 1.15-μm wavelength of a helium--neon laser, 32:19555

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

URANIUM ORES/GEOCHEMISTRY
Change of uranium concentration in plagioclase of various zones of microcline--albite--oligoclase pegmatites of Karelia, 32:19704
URANIUM ORES/LEACHING
Preparation of uranium compounds (Patent), 32:19329
URANIUM ORES/MINING
The uranium mining and its importance for the energy supply, 32:19701
URANIUM ORES/ORE PROCESSING
Supplies for the fuel cycle for Spanish nuclear power plants, 32:19702
URANIUM OXIDES
See also URANIUM DIOXIDE
URANIUM OXIDES U3O8

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

20457 (LA-5954) 100-MHz POWER AMPLIFIER DESIGN AND CONTROL FOR A HEAVY-ION ACCELERATOR. Lunsford, J. S.; Shipley, J. P.; Sutton, J. **(Los Alamos Scientific Lab., N. Mex. (USA)).** Jul 1975. 11p. Dep. NTIS $4.00.

is indexed as:

LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)
100-MHz power amplifier design and control for a heavy-ion accelerator, 32:20457 (LA-5954)
Characterization of transuranic solid wastes from a plutonium processing facility, 32:19398 (LA-5993-MS)
Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen, 32:19495 (LA-UR-75-1032)
Engineering concepts for laser-fusion reactor applications, 32:19493 (LA-UR-75-736)
Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets, 32:19583 (LA-UR-75-1099)

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Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 33, Number 3 February 15, 1976

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Activation and Nuclear Reaction Procedures

Refer also to abstracts 5042, 5606, and 6677.

4943 (NIM-1762) DETERMINATION: BY INSTRUMENTAL NEUTRON-ACTIVATION ANALYSIS, OF SOME ELEMENTS IN THE NIMROC STANDARD REFERENCE MATERIALS. Eddy, B. T.; Pearton, D. C. G.; Bibby, D. M. (National Inst. for Metallurgy, Johannesburg (South Africa)). 22 Sep 1975. 10p. Dep. NTIS (US Sales Only) $4.50.

Instrumental neutron-activation analysis was used for the determination of sixteen trace and minor elements in the six NIMROC reference materials. Six reference rock materials prepared by the U.S. Geological Survey were also analysed, and the results were compared with the recommended, average, or magnitude values given for these rocks by Flanagan. The agreement between the two sets of results was found to be generally good, indicating that INAA is an acceptable technique for the determination of most of these elements. The values found for the NIMROC samples represent a significant contribution to the evaluation of the trace elements in these reference materials. (auth)

4944 DETERMINATION OF MERCURY IN SELECTED FISHES LIVING IN TURKISH COAST BY NEUTRON ACTIVATION ANALYSIS. Olmez, I.; Aras, N. K. (Ankara Nuclear Research Center). Radiochem. Radioanal. Lett.; 22: No. 1, 19-23(30 Jun 1975).

Mercury contents of selected fishes in Agean Sea Coast of Turkey were determined by neutron activation analysis. In general, the level of mercury found in these samples are below limits of standards set by many countries. (auth)

4945 FIREARM RESIDUE DETECTION BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Rudzitis, E. (Illinois Bureau of Identification, Joliet); Wahlgren, M. J. Forensic Sci. Soc.; 20: No. 1, 119-124(Jan 1975).

Work leading to an improved technique for firearm discharge residue detection by neutron activation is described. The troublesome and time-consuming postirradiation chemistry has been eliminated; also, sample size has been minimized to accommodate some 130 samples per irradiation capsule. To put the method in a proper perspective, previous work has been referenced and discussed. (auth)

4946 DETERMINATION OF THE CONCENTRATION OF SOME ELEMENTS BY CHARGED PARTICLE ACTIVATION ANALYSIS. Bykov, A. M.; Muminov, V. A.; Mukhammedov, S.; Sultanov, B.; Khaidarov, R. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 3, 25-27(1975). (In Russian)

The use of protons, deuterons, and ^{3}He for the activation analysis of Mg, Al, Si, S, K, Ca, Cr, Fe, Ni, and Mo was studied. The sensitivities obtained were compared with that obtained in activation analysis by thermal and fast neutrons and by γ radiation. The sensitivities appeared higher with the charged particle analysis. Analysis of semiconductor Si and ammonium paramolybdate confirmed this conclusion. (JSR)

4947 DETERMINATION OF THE CONTENT OF CARBON, OXYGEN, AND NITROGEN IN FRACTIONS HYMATOMELANIC ACID BY USE OF (γ,n) PHOTONUCLEAR REACTIONS. Kasymov, A. K.; Khakimov, M. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 3, 33-34(1975). (In Russian)

Samples of hymatomelanic acid in the form of tablets were exposed to bremsstrahlung radiation, resulting in the formation of the positron-decay isotopes ^{11}C, ^{15}O, and ^{13}N from the (γ,n) reaction of ^{12}C, ^{16}O, and ^{14}N. The positrons were detected with a scintillation counter. The results obtained agreed well with a chemical analysis of the acid. (JSR)

4948 DETERMINATION OF IMPURITIES IN SODIUM IODIDE AND SODIUM CHLORIDE BY NEUTRON ACTIVATION ANALYSIS. Damburg, N.; Mikelson, G.; Virtsavs, M. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 3, 3-7(1975). (In Russian)

Instrumental neutron activation analysis of sodium iodide and sodium chloride using Ge(Li) gamma spectrometry and long-lived radioisotopes was carried out. The detection limits and the concentration of elements Sc, Fe, Co, Zn, Se, Sb, Eu, and Ir are given. (auth)

4949 NONDESTRUCTIVE DETERMINATION OF MICRO-AMOUNTS OF URANIUM AND THORIUM IN MATERIALS OF COMPLEX CHEMICAL COMPOSITION. Ganzorig, Zh.; Dashzeveg, L.; Otgonsuren, O.; Khuukhenkhuu, G.; Chadraabal, I.; Chultem, D. Sov. Radiochem.; 16: No. 2, 249-253 (1974).

Translated from Radiokhimiya; 16: No. 2, 247-253(1974).

The use of resonance (epithermal) neutrons with energies of $1\text{-}10^{-4}$ eV makes it possible to carry out nondestructive analysis for uranium and thorium through their selective activation. A procedure is described for this analysis using the beam of the IBR-30 reactor at OIYaI. (LK)

4950 NEUTRON ACTIVATION ANALYSIS APPLIED TO ENERGY AND ENVIRONMENT. Lyon, W. S. (Holifield National Lab., Oak Ridge, TN). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 56(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

4951 RECREATING THE PRE-COLUMBIAN PAST: THE APPLICATION OF NUCLEAR PHYSICS TO MESOAMERICAN ARCHAEOLOGY. Grennes-Ravitz, R. A. (Virginia Military Inst., Lexington); Wilson, R. D. Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 56-57(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

4952 MEASUREMENT OF THE OXYGEN CONTENT OF URANIUM OXIDE FUEL AND STAINLESS STEEL. Holland, L.; Machado, E. L.; Calado, C. E. (Instituto de Energia Atomica, Sao Paulo, Brazil). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 58-60(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

4953 DETERMINATION OF METALS IN ALLOYS BY NEUTRON-CAPTURE γ-RAY SPECTROMETRY. Heurtebise, M.; Lubkowitz, J. A. (Instituto Venezolano de Investigationes Cientificas, Caracas). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 60-61(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

4954 DETERMINATION OF MANGANESE IN ORES BY ACTIVATION ANALYSIS USING A ^{252}Cf NEUTRON SOURCE. Cardoso, A.; Lima, F. W. (Instituto de Energia Atomica, Sao Paulo, Brazil). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 61(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Chemical and Spectral Procedures

Refer also to abstract 5647.

4955 (ARH-CD--474) ISOTOPIC ANALYSIS OF PLUTONIUM BY COMPUTER CONTROLLED MASS SPECTROMETRY. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 10 Apr 1974. Contract E(45-1)-2130. 42p. Dep. NTIS $5.00.

Isotopic analysis of plutonium chemically purified by ion exchange is achieved using a thermal ionization mass spectrometer. Data acquisition from and control of the instrument is done automatically with a dedicated system computer in real time with subsequent automatic data reduction and reporting. Separation of isotopes is achieved by varying the ion accelerating high voltage with accurate computer control. (auth)

4956 (KFK-1905/1) INTERLABORATORY EXPERIMENT IDA-72 ON MASS SPECTROMETRIC ISOTOPE DILUTION ANALYSIS. Keyrich, W.; Drosselmeyer, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Spaltstoffflusskontrolle). Jul 1975. 235p. (EUR-5203e). Dep. NTIS (US Sales Only) $9.00.

An analytical intercomparison program was carried out in cooperation with 22 laboratories of 13 countries or international organizations. The main objective was the acquisition of basic data on the errors involved in the mass spectrometric isotope dilution analysis if it is applied to the determination of uranium and plutonium in diluted active feed solutions of reprocessing plants in routine operation. The results were evaluated by statistical methods mainly in regard to the calculation of the estimates of the variances for the different error components contributing to the total error of this analytical technique. Furthermore, the performance of two new methods for sample conditioning suggested by the International Atomic Energy Agency, Vienna, and the European Institute for Transuranium Elements (EURATOM), Karlruhe, was successfully tested. The results of some investigations on the stability of diluted high active feed solutions and on comparison analyses by x-ray fluorescence spectrometry are also included. Data on the analytical efforts (manhours) invested in this study are reported as well as general experiences made in the organization and performance of an experiment on such an extended international level. (auth)

4957 (KFK-1905/2) INTERLABORATORY EXPERIMENT IDA-72 ON MASS SPECTROMETRIC ISOTOPE DILUTION ANALYSIS. Beyrich, W.; Drosselmeyer, E. (eds.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Spaltstoffflusskontrolle). Jul 1975. 266p. (EUR-5204e). Dep. NTIS (US Sales Only) $10.00.

Volume II of the report on the IDA-72 experiment contains papers written by different authors on a number of special topics connected with the preparation, performance and evaluation of the interlaboratory test. In detail the sampling procedures for active samples of the reprocessing plant and the preparation of inactive reference and spike solution from standard material are described as well as new methods of sample conditioning by evaporation. An extra chapter is devoted to the chemical sample treatment as a preparation for mass spectrometric analysis of the U and Pu content of the solutions. Special topics are also methods for mass discrimination corrections, α-spectrometer measurements as a supplement for the determination of ^{238}Pu and the comparison of concentration determinations by mass spectrometric isotope dilution analysis with those performed by x-ray fluorescence spectrometry. The last part of this volume contains papers connected with the computerized statistical evaluation of the high number of data. (auth)

4958 (LA-6039) ACCURATE DETERMINATION OF IMPURITY CONCENTRATIONS IN PLUTONIUM METALS BY STATISTICAL EVALUATION OF ANALYTICAL DATA. Martell, C. J.; Tietjen, G. L.; Horita, M. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 48p. Dep. NTIS $4.00.

Analytical data from a plutonium-metal exchange program conducted by six ERDA laboratories are statistically evaluated. The objective is an accurate determination of five metal impurities (aluminum, chromium, iron, nickel, silicon) in each of three plutonium metals by using data from four analytical methods. The statistical evaluation yields the weighted mean and its standard deviation for each method, plutonium metal, and impurity, using a procedure that minimizes the effect of outliers by assigning zero weights to the most extreme values and variable weights to the remaining data. Where possible, weighted means from the various analytical methods are pooled. (auth)

4959 ISOTOPIC ANALYSIS BY OPTICAL SPECTROSCOPY. Ungureanu, C. (Inst. for Stable Isotopes, Cluj). Isotopenpraxis; 11: No. 7, 237-242(Jul 1975).

Different methods of isotopic analysis for hydrogen, nitrogen, and oxygen are described. In the cases of hydrogen and oxygen, a light source with high frequency excitation and a Fabry-Perot spectrometer with photoelectric recording were employed. For nitrogen a Zeiss Q-24-spectrograph, or a Zeiss SPM-2 monochromator, converted to photoelectric automatic recording instruments was used. In the last case the method was extended for determining the nitrogen isotopic concentration in nitric oxide gas. (auth)

4960 ISOTOPIC SPECTRAL ANALYSIS OF HYDROGEN IN A HOT CATHODE FIELD. Zakorina, N. A.; Petrov, A. A. Zh. Prikl. Spektrosk.; 23: No. 2, 195-200(Aug 1975). (In Russian).

The singularities and characteristics of the spectral determination of the isotopic composition of hydrogen by the hot cathode field method were discussed. The reproducibility, precision, sensitivity with respect to the isotope composition, and absolute sensitivity were determined. (JSR)

4961 IODINATION OF HERPESVIRUS NUCLEIC ACIDS. Shaw, J. E.; Huang, E. S.; Pagano, J. S. (Univ. of North Carolina, Chapel Hill). J. Virol.; 16: No. 1, 132-140(Jul 1975).

A simple method is described for the iodination of herpes simplex virus (HSV) DNA. The procedure involved synthesis of ^{125}I-labeled 5-iodo-dCTP which was subsequently used as a precursor for the in vitro repair synthesis of HSV DNA. Synthesis of 5-iodo-dCTP and purification from oxidation and reduction reagents, buffer salts, unreacted dCTP and $Na^{125}I$-labeled HSV DNA in vitro with specific activities exceeding 10^8 counts/min/mu g. The DNA prepared by this method reassociated with DNA extracted from HSV-infected HEp-2 cells but not with HEp-2 cell DNA. Iodinated HSV DNA was susceptible to S_1-endonuclease digestion once denatured but was resistant to digestion in the native form. This method was used to synthesize ^{125}I-labeled ribo-CTP (5-iodo-CTP) which was used to prepare cytomegalovirus-specific complementary RNA. The method should be of value in the preparation of viral probes and for use in autoradiography of viral nucleic acids. (auth)

4962 WAY TO REDUCE THE NUMBER OF STANDARDS FOR SPECTROGRAPHIC ANALYSIS. Burmistrov, M. P.; Moreiskaya, L. V. (State Scientific-Research and Design Inst. of Alloys and Non-Ferrous Metal Working, Moscow). Zh. Anal. Khim.; 30: No. 8, 1477-1483(Aug 1975). (In Russian)

To reduce the number of standards for spectrographic analysis (this would allow the analysis of a group of single-type alloys by using one set of standards), the calibration plots for determining Fe, Pb, Zn, and Mg in four copper-based alloys, which are different in the contents of V, Mo, Co, and Cd were compared by the method of regression analysis. The analysis of the alloys by the method of globe arc using copper oxide standards and by the quantometric method using copper metal standards leads to significant systematic errors in the determination of Fe, Pb, and Mg. Both methods allow the analysis of all four alloys using standards of average chemical composition of the alloys. (auth)

4963 DETERMINATION OF CADMIUM AND TELLURIUM IN CADMIUM TELLURIDE BY PAPER PEAK CHROMATOGRAPHY. Rasechnova, R. A.; Bardin, V. V.; Mokhov, A. A. (Leningrad Technological Inst.). Zh. Anal. Khim.; 30: No. 8, 1497-1500 (Aug 1975). (In Russian)

A method of paper peak chromatography is suggested to determine cadmium microamounts in the presence of tellurium at the ratio of the components of 1:1. The method permits the determination of cadmium with a relative standard deviation of 0.014 at the minimum content (0.15 μg) that can be determined in the sample. (auth)

4964 EXTRACTION-PHOTOMETRIC DETERMINATION OF THE YTTRIUM SUBGROUP RARE EARTHS IN THE PRESENCE OF LANTHANUM AND CERIUM. Poluektov, N. S.; Lauer, R. S.; Ovchar, L. A.; Potapova, S. F. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 30: No. 8, 1513-1517(Aug 1975). (In Russian)

The rare earth ions (RE) react with 3,5-dinitrocatechol (DNC) and rhodamine B (Rhod) to form ion associates which are extracted by a mixture of benzene and isobutanol (9:1). The ratio

of the components in the molecule Re : DNS : Rhod = 1 : 4 : 1. An extraction-photometric procedure was developed for determining gadolinium in the presence of lanthanum. The lanthanum and cerium complexes are not formed at a relatively small excess of rhodamine S in respect to RE that is the basis of the procedure. (auth)

4965 USE OF COULOMETRY WITH POTENTIAL SCANNING IN ANALYTICAL CHEMISTRY. III. Determination of Uranium. Skiyarenko, I. S.; Chubukova, T. M.; Sentyurin, I. G. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 30: No. 8, 1527-1531(Aug 1975). (In Russian)

The electrochemical behavior of uranium (VI) was studied at a platinum electrode in hydrochloric, nitric, and sulfuric acid solutions by coulometry with linear potential scanning. The possibility of determining uranium is demonstrated. A procedure is suggested for determining uranium and plutonium from one sample in the presence of some impurities. The relative standard deviation of determining 1 to 20 mg U and about 100 μg Pu is not more than 0.01. (auth)

4966 OMEGATRON–ISOTOPIC METHOD FOR DETERMINATION OF NITROGEN IN METALS. Galkin, M. A.; Ivanova, T. F.; Fedorov, V. V. Zh. Anal. Khim.; 30: No. 8, 1548-1550 (Aug 1975). (In Russian)

Under optimal operating conditions, a serial omegatron RMO-4S may be successfully used to determine isotope concentration of nitrogen in metals (steels and W) by the isotope dilution method. The determinations sensitivity is 6.10^{-5} weight per cent, the coefficient of variation for average concentration being ±6 per cent. (auth)

4967 HIGH-FREQUENCY CONDUCTOMETRIC DETERMINATION OF PEROXIDE COMPLEX OF NIOBIUM USING SODIUM NITRITE. Lopatin, B. A.; Lukianets, I. G.; Kotlyarova, T. I. (Kuban State Univ., Krasnodar, USSR). Zh. Anal. Khim.; 30: No. 8, 1551-1555(Aug 1975). (In Russian)

Hydrogen peroxide, which forms a 1 : 1 complex with niobium, reacts very slowly with sodium nitrite in 1 to 2 M sulfuric acid. On the basis of this reaction, a method is suggested of high-frequency conductometric determination of niobium using a contact R-sell. The method was tested on niobium pentoxide samples and on a niobium metal standard. A similar method is suggested for determining niobium in fluoride solutions. (auth)

4968 DETERMINATION OF TANTALUM IN RARE EARTH TANTALATES BY THE DIFFERENTIAL PHOTOMETRIC METHOD. Piryutko, M. M.; Benediktova, N. V. (Inst. of Chemistry of Silicates, Leningrad). Zh. Anal. Khim.; 30: No. 8, 1556-1559 (Aug 1975). (In Russian)

The reactivity of tantalum in hydrochloric and sulfuric acid peroxide solutions was examined in respect to pyridinazoresorcinol (PAR) as a function of acid concentration and tantalum concentration in time. A differential photocolorimetric method is suggested for determining tantalum with PAR in the peroxide medium at pH 4. In the analysis of standard solutions of tantalum pentoxide, the coefficient of variation is 0.6% at n = 23 for the samples with the contents of 41.9 and 71.8%; the coefficient equals 0.8 and 0.7% at n = 5 and 6 respectively. (auth)

4969 CHEMICAL-SPECTROGRAPHIC METHODS OF ANALYSIS OF SEMICONDUCTOR TELLURIUM AND TELLURIDES OF SOME SECOND GROUP ELEMENTS. Tiptsova-Yakovleva, V. G.; Dvortsan, A. G.; Semenova, I. B. (Moscow Inst. of Steel and Alloys). Zh. Anal. Khim.; 30: No. 8, 1577-1583(Aug 1975). (In Russian)

A chemical-spectrographic method was developed for determining Pb, Bi, Cr, Ni, Co, Mo, Ti, V, As, Tl, Al, In, Ga, Mn, Sn, Zn, Cd, W, Fe, Cu, Mg, Sb as impurities in 0.5 g of tellurium with sensitivities 10^{-6} to 10^{-4}%. These elements (except for Mo, Sn, Ti, V, W) were determined in 1 g of mercury telluride with sensitivities 10^{-7} to 10^{-5}%. A chemical–spectrographic method was also suggested for determining Al, In, Cu, Ga, Pb, Cr, Zn, Ti, Sn, V, W, Mo, Sb, As, Bi, and Fe as impurities in cadmium telluride and in mixed telluride of cadmium and mercury with sensitivities 10^{-7} to 10^{-5}%. Conditions for concentration of the impurities from these compounds and for spectrographic analysis of concentrates were examined. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 5082, 5083, 5582, 5604, and 5633.

4970 (CNAEM-R-147) RADIOMETRIC DETERMINATION OF THORIUM IN MINERALS FROM TURKEY. Uzmen, R.; Ipekoglu, B. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1975. 11p. (In French). Dep. NTIS (US Sales Only) $4.50.

There is a great need for rapid and continuous analysis of thorium during the physical enrichment processes of the Turkish thorium minerals; consequently a quantitative determination curve of thorium was drawn by counting the 0.24-MeV γ ray peak of ^{212}Pb which is in isotopic equilibrium with ^{232}Th. The use of standard thorium component was useless, since quantitative determination of thorium in the mineral was carried out beforehand by chemical methods. (auth)

4971 (UCRL-52000-75-8, pp 17-18) NATIONAL SECURITY. Aug 1975.

In Lawrence Livermore Laboratory energy and technology review. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

An x-ray-fluorescence analysis system is being developed for determining uranium and plutonium concentrations in the solution obtained when the fuel rods from light-water power reactors are dissolved in nitric acid. These concentrations are needed to inventory the uranium and plutonium handled in fuel reprocessing plants. This technique should make it possible to analyze dissolver solution with speed and a 0.5 percent accuracy. (auth)

4972 EXPRESS ANALYSIS OF MIXTURES OF RADIOACTIVE GASES AND VAPORS IN THE STUDY OF DEHYDRATION PROCESSES OF HYDROXIDES. Teplyakov, V.V.; Bekman, I. N.; Zaborenko, K. B. Sov. Radiochem.; 16: No. 2, 288-290(1974).

Translated from Radiokhimiya; 16: No. 2, 283-285(1974).

A variant of a combined emanation-thermal apparatus was developed, which makes it possible to carry out a continuous analysis of the radioactive inert gases liberated and labeled gaseous products of a reaction in the solid phase under conditions of rapid change in their concentrations. Titanium hydroxide labeled with tritium and radon 226 was used in the study. (LK)

4973 USE OF LIQUID SCINTILLATION FOR THE DETERMINATION OF $^{14}CO_2$. Rowinska, L.; Walis, L.; Wezranowski, E. (Inst. for Nuclear Research, Warsaw). Isotopenpraxis; 11: No. 7, 252-255(Jul 1975). (In German).

The possibility of the determination of small amounts of CO_2 in a gas mixture (ammonia and its dissociation products) in the nitriding of steel was tested and a measurement method was developed. The carbon in the steel was labelled with ^{14}C. The $^{14}CO_2$ produced was absorbed in β-aminoethyl alcohol. Its activity was measured with a liquid scintillator and a β spectrometer. The counting rate was about 68%. The method developed makes it possible to determine a minimum activity of $(6.82 \pm 2.2) \times 10^{-12}$ Ci in about 40 min time. (tr-auth)

4974 METHOD FOR COUNTING SIX GAMMA NUCLIDES SIMULTANEOUSLY IN A THREE CHANNEL COUNTER. Culp, H. W.; Daniels, W. D.; Pieper, D. J.; Pollock, G. D.; Sanders, R. W. (Lilly Research Labs., Indianapolis). Anal. Biochem.; 68: No. 1, 155-160(Sep 1975).

A method is described for counting up to six gamma nuclides simultaneously in a three channel counter. It requires two counting passes and a description is given of the counter modification which automatically adjusts the windows between passes. The variance in the results is a function of count rate and counting time and it shows remarkable uniformity for all nuclides. (auth)

4975 CLINICAL USES OF STABLE INDICATORS ASSAYED IN VITRO BY FLUORESCENCE EXCITATION ANALYSIS. Kaufman, L. (Univ. of California, San Francisco). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 62(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

4976 DETECTION OF IMPERFECTIONS BY MEANS OF NARROW BEAM GAMMA SCATTERING. Bukshpan, S.; Kedem, D.; Kedem, D. (Sorq Nuclear Research Center, Yavne, Israel). Mater. Eval.; 33: No. 10, 243-245(Oct 1975).

A new approach for the detection of flaws in materials is proposed, making use of backscattered gamma radiation from a ^{192}Ir source. The technique permits the detection of flaws by approaching the material only from the same side as that of the incident radiation. (auth)

Separation Procedures

Refer also to abstracts 4996, 5043, 5091, and 5314.

4977 (ANL-Trans-1002) INFLUENCE OF THE GEOMETRY PROPERTIES OF SUPPORT MATERIALS ON THE EFFICIENCY OF AN EXTRACTION CHROMATOGRAPHY SYSTEM. II. Variation of the Exchange Kinetics of Eu^{3+} in the HDEHP*–SiO_2–HCl System as a Function of the Pore Size of the Support Materials (Matrices). Specht, S.; Nolte, R. F.; Born, H. J. Translated from J. Chromatogr.; 110: 253-264(1975). 14p. Dep. NTIS $4.50.

The kinetics of europium exchange were studied as a function of the pore size of the solid support with the HDEHP-HCl partition chromatography system. Spherical silica gel particles with an average diameter of 56 mu m were investigated and found to have surfaces between 1 and 195 m^2/g and the median pore diameter in the range of 117-5,500 A. The coating of the silylated support material was 10 percent by weight. The kinetics of the europium exchange were found to be a heterogenous, transport-controlled reaction in the aqueous phase. The unsteady exchange is described by Fick's second law. The transportation of the HDEHP-molecules from the interface into the aqueous phase must be considered to be the rate-determining step. Its length (equals distance between the interface and the layer where the complex ion is formed) as well as the variable hindrance due to different pore size of this rate-determining step was investigated. Four pore size ranges were discussed, in each of which the transport reaction is hindered to a greater or smaller extent. Thus we could demonstrate that in the case of a pore size range with pore diameters greater than 2 mu m the rate of exchange is comparable to the rate of a solvent extraction system. The variation of the rate of exchange with increasing coating of the solid support with HDEHP could be explained in the light of the above results due to the influence of the HDEHP-solubility in the aqueous phase. (auth)

4978 (DP-1391) SOLVEX: A COMPUTER PROGRAM FOR SIMULATION OF SOLVENT EXTRACTION PROCESSES. Scotten, W. C. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1975. Contract AT(07-2)-1. 35p. Dep. NTIS $4.00.

SOLVEX is a FORTRAN IV computer program that simulates the dynamic behavior of solvent extraction processes conducted in mixer-settlers and centrifugal contactors. Two options permit terminating dynamic phases by time or by achieving steady state, and a third option permits artificial rapid close to steady state. Thus the program is well suited to multiple phases of dynamic problems and multiple input of steady state problems. Changes from the previous problem are the only inputs required for each succeeding problem. Distribution data can be supplied by two-variable third-power polynomial equations or by three-variable tables in any one of 16 different combinations involving phase concentrations or distribution coefficients (ratio of phase concentrations) or their logarithms. (auth)

4979 (GAT-T-2374) CHROMIUM RECOVERY FROM SLUDGES PRODUCED FROM CHROMATE-INHIBITED COOLING WATER. Deacon, L. E.; Holland, M. E.; Kaplan, R. I. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 12 Sep 1975. Contract E(33-2)-1. 16p. (CONF-750967-5). Dep. NTIS $4.00.

From 3rd ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

Laboratory investigations of methods to reclaim chromium from sludge are summarized. Among the methods tried were wet oxidation techniques using peroxide, persulfate, and permanganate salts as oxidants and gaseous oxidation techniques using ozone, chlorine, and fluorine. However, the most successful and technically feasible approach discovered was calcination of the sludge with added soda ash at 850 to 900°C for about 30 minutes in an open-air calciner. Recovery yields of up to 75 percent were recorded. Calcination converts the chromium to sodium chromate, which is water-leachable and, hence, can be returned to the cooling water system. Residue after leaching may contain sufficient lime to warrant its reuse as a precipitation agent in the process. (auth)

4980 EXTRACTION OF TERBIUM FROM A MOLTEN EUTECTIC WITH A THREE-COMPONENT SOLVENT SYSTEM. Lengyel, T. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 22: No. 1, 49-52(30 Jun 1975).

In continuing the extraction studies of terbium from the molten eutectic lithium nitrate–ammonium nitrate the solvent system composed of tri-n-butyl phosphate, 2-thenoyltrifluoroacetone and 2,2'-bipyridyl has been investigated. The results of the equilibrium measurements reveal synergistic enhancements of the distribution ratios. (auth)

4981 RAYLEIGH DISTILLATION EXPERIMENTS WITH RESPECT TO THE SEPARATION OF DEUTERIUM FROM DILUTE SOLUTIONS IN LITHIUM. Ihle, H. R.; Wu, C. H. (Institut fuer Chemie der Kernforschungsanlage, Juelich, Ger.). J. Phys. Chem.; 79: No. 22, 2386-2388(23 Oct 1975).

The ratio of the atom fraction of deuterium in the gas phase, x/sub D,g/, to that in the liquid, x/sub D,l/, R equals x/sub D,g// x/sub D,l/, was determined by Rayleigh distillation of dilute solutions of deuterium in lithium in the temperature range from 1000 to 1600°K. With an initial atom fraction x/sub D,l/ equals 10^{-5}, enrichment of deuterium in the gas phase was observed at temperatures above 1240°K. The dependence of R on temperature can be expressed by the equation ln R equals $-[(8.47 \pm 0.45) \times 10^3/T] + (6.94 \pm 0.55)$. This result agrees well with the R values calculated from the measured vapor pressures of the gas species Li_2D, LiD, and D_2 over dilute solutions of deuterium in lithium. The thermodynamic supposition that deuterium can be removed from highly dilute solutions in lithium by distillation at high temperatures is shown by the experimental results to be correct. The same effect is expected for solutions of tritium in lithium. (auth)

4982 EXTRACTION FROM HYDROCHLORIC ACID SOLUTIONS WITH TRIBUTYL PHOSPHATE. VIII. Extraction of Molybdenum from HCl Solutions. Levin, V. I.; Titkova, T. D. Sov. Radiochem.; 16: No. 2, 267-268(1974).

Translated from Radiokhimiya; 16: No. 2, 267-268(1974).

An investigation was made of the extraction of microamounts of molybdenum by TBP from HCl solutions up to a concentration of 10 N. It was shown that with an HCl activity in the aqueous phase ≥ 50, in addition to the complex $MoO_2-Cl_2 \cdot 2TBP$, the acido complex $HMoO_2Cl_3 \cdot 2TBP$ is extracted and the extraction constant of the latter equals $(1.5 \pm 0.1) \times 10^{-4}$. The stability constant of the chloride complex MoO_2Cl^+ was estimated and found to equal 0.095 ± 0.007. (auth)

4983 ELECTROCHEMICAL METHOD OF ISOLATING PLUTONIUM FROM A PEROXIDE–ALKALI MEDIUM. Gurevich, A. M.; Osicheva, N. P.; Solntseva, L. F. Sov. Radiochem.; 16: No. 2, 227-229(1974).

Translated from Radiokhimiya; 16: No. 2, 226-228(1974).

An electrochemical method is proposed for isolating plutonium with uranium as the carrier from a peroxide–alkali medium and this can be used for analyzing salt solutions of complex composition. (auth)

4984 EXTRACTION OF CESIUM AND RUBIDIUM WITH A BINARY MIXTURE OF DI-2-ETHYLHEXYLPHOSPHORIC ACID AND 2-PHENYLPHENOL. Smelov, V. S.; Lanin, V. P. Sov. Radiochem.; 16: No. 2, 181-186(1974).

Translated from Radiokhimiya; 16: No. 2, 180-185(1974).

The extraction constants of mixed complexes of cesium and rubidium with a mixture of di-2-ethylhexylphosphoric and 2-phenylphenol. (LK)

4985 EXTRACTION BY ORGANOPHOSPHORUS ACIDS. I. Effect of Composition and Structure of Phosphonic Esters on the Extraction of Trivalent Cations of Transplutonium and Rare-Earth Elements. Zaitsev, A. A.; Nazarova, I. I.; Petukhova, I. V.; Filimonov, V. T.; Yakovlev, G. N. Sov. Radiochem.; 16: No. 2, 177-180(1974).

Translated from Radiokhimiya; 16: No. 2, 176-179(1974).

It was shown that isoesters of phenylphophonic acids are more promising for the separation of the pair californium–curium than the normal esters. It was shown that lengthening the ester radical from C_5 to C_{10} leads to an increase in the extraction power of the phosphonates. Branching of the ester radical reduces the extraction power of the phosphonates with the extraction of curium falling more rapidly than that of californium, leading to an improvement in their separation. It was shown that the nature of the mineral acid affects to a considerable degree the distribution of the elements and also their separation. The following order was established for the distribution coefficients and the separation factors of californium and curium $HClO_4 > HCl \geq HNO_3$. (auth)

4986 RATE OF EXTRACTION OF Pu(IV) FROM NITRIC ACID SOLUTION BY TRIBUTYL PHOSPHATE. Fomin, V. V.; Leman, G. A. Sov. Radiochem.; 16: No. 2, 167-176(1974).

Translated from Radiokhimiya; 16: No. 2, 166-176(1974).

It was shown that in the extraction of tracer amounts of plutonium fron nitric acid solutions by mixtures of TBP and CCl_4 in cells with a constant interphase surface at 20-22°C the process occurs under diffusion conditions. The hypothesis was put forward that the observed results are explained by the fact that one phase, probably the organic phase, offers resistance. The relation of the extraction rate at the initial moment (t = 0) to the concentrations of HNO_3 and TBP may be explained by the corresponding relation to the distribution coefficient to these concentrations, but not the rate of the surface chemical reaction (the process does not occur under kinetic conditions. (auth)

4987 SORPTION OF IONS OF SOME POLYVALENT ACTINIDE AND RARE-EARTH ELEMENTS BY A CATIONITE WITH A

PHTHALIC FUNCTIONAL GROUP. Nikol'skii, B. P.; Krylov, L. I.; Zakhvataev, B. B. Sov. Radiochem.; 16: No. 2, 163-166 (1974).

Translated from Radiokhimiya; 16: No. 2, 162-166(1974).

A study was made of the sorption of uranium(VI), hafnium(IV), plutonium(IV), and europium(III) by KMAF phthalic resin from nitric acid solutions with an ionic strength J = 1.0 ($NaNO_3$). The distribution coefficients of the elements studied between the solution and the KMAF resin were determined. The distribution coefficients of plutonium and hafnium are considerably higher (by a factor of ~200-230) than those of europium and uranium at pH = 2.0. A comparison of the separation factors obtained on KMAF and KB-4 resins shows that the ionite with the phthalic functional group shows an appreciable specific tendency to sorb tetravalent elements. We determined the exchange constants of the Na^+ ion in the resin for the metal ion in solution and these were as follows: for plutonium(IV) $-3.98 \cdot 10^5 \pm 60$, for uranium(VI) $-3.16 \cdot 10^3 \pm 35$, and for europium(III) $-2 \cdot 10^3 \pm 60\%$. (auth)

4988 ISOLATION OF TRANSPLUTONIUM ELEMENTS ON ANIONITIES BY MEANS OF AQUEOUS ALCOHOL SOLUTIONS OF NITRIC ACID AND AMMONIUM THIOCYANATE. Guseva, L. I.; Tikhomirova, G. S. Sov. Radiochem.; 16: No. 2, 153-156 (1974).

Translated from Radiokhimiya; 16: No. 2, 152-156(1974).

An investigation was made of the effect of the alcohol content, the NH_4CNS concentration, HCl, and the nature of the alcohol in the solution on the distribution coefficients of curium and europium and also the half-width of the elution curve of Eu from anionites containing 4 and 8% divinylbenzene. It was shown that the group separation of TPE and REE is best carried out with methanol solutions on NH_4CNS acidified with HCl and resins with a lower content of divinylbenzene since in this case the elements are eluted on a narrower front and the separation is sharper. A method is proposed for isolating transplutonium elements from a large number of elements of the Periodic Table with the simultaneous separation of the light TPE on anionites by means of aqueous alcohol solutions of nitric acid and ammonium thiocyanate. (auth)

4989 ADSORPTION OF SO_4^{2-} ION ON BARIUM SULFATE. Grebenshchikova, V. I.; Pershin, A. S.; Challyan, K. N. Sov. Radiochem.; 16: No. 2, 262-264(1974).

Translated from Radiokhimiya; 16: No. 2, 262-264(1974).

By means of a method which made it possible to distinguish between adsorption and isotope exchange we determined the adsorption of SO_4^{2-} ions on $BaSO_4$ and obtained a value of the order of $\sim 5 \times 10^{-4}$ mg-equiv/g. It was shown that the adsorption of the SO_4^{2-} ion on the surface of $BaSO_4$ leads to the loss of hydrogen ion from the solution. It was established that there is a loss of hydrogen ion is all cases when the SO_4^{2-} ion is replaced by NO_3^-, ClO_4^-, and $C_2O_4^{2-}$ anions. (auth)

4990 CALCULATED AND EXPERIMENTAL RESULTS FOR THE ISOLATION OF ALKALINE EARTH ELEMENTS BY DISPLACEMENT COMPLEX-FORMATION CHROMATOGRAPHY. Korshunova, S. P.; Maslova, G. B.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 12, 1797-1798(Dec 1974).

Translated from Zh. Fiz. Khim.; 48: No. 12, 3074-3077(Dec 1974).

A displacement complex-formation chromatographic method is proposed for the separation of calcium, strontium, and barium, using a solution of sodium ethylenediaminetetraacetate as the eluent. The elution curves for different compositions of the eluent were calculated to select the separation conditions. The calculation was made for concentrations of 0.015, 0.05, 0.1, 0.15, and 0.2 M and for degrees of neutralization of 75 and 88%. A satisfactory agreement was achieved between the calculated and experimental results. Results of the calculation were used to separate a mixture of calcium, strontium, and barium. (auth)

4991 MECHANISM OF THE SORPTION OF METAL IONS BY CARBOXYLIC ACID CATION-EXCHANGE RESINS. XV. The Sorption of Uranyl Ions by KB-2 Resin. Chuveleva, E. A.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 12, 1795-1797(Dec 1974).

Translated from Zh. Fiz. Khim.; 48: No. 12, 3071-3073(Dec 1974).

The interaction of uranyl ions with the carboxy groups of KB-2 cation-exchange resin was investigated by potentiometric titration. The uranyl ion forms complexes with the compositions $[UO_2(RCOO)_2]$ and $[UO_2(RCOO)_3]^-$. The stabilities of the complexes formed in the resin phase were determined. (auth)

4992 THERMODYNAMIC ANALYSIS OF THE EXTRACTION OF GROUPS VI TO VIII METALS BY THERMAL DISSOCIATION OF THEIR CARBONYLS. Syrkin, V. G. Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 12, 1718-1720(Dec 1974).

Translated from Zh. Fiz. Khim.; 48: No. 12, 2927-2930(Dec 1974).

The main reactions involved in thermal dissociation of the carbonyls of osmium, rhenium, manganese, cobalt, tungsten, molybdenum, chromium, iron, and nickel were surveyed, and the Gibbs' free energies were calculated from 200° to 1000°K. Thermodynamic analysis established for the first time that the tendency of metal carbonyls to thermal dissociation diminishes in the sequence from trinuclear through dinuclear to mononuclear. The slope of the linear temperature dependence of the free energy is approximately constant for each of these types of carbonyls. The temperature limits of the thermal dissociation of various metal carbonyls were established for the first time by the thermodynamic analysis. Calculated results were confirmed by experiment. (auth)

4993 CHROMATOGRAPHIC SEPARATION OF CURIUM, AMERICIUM, AND THE LANTHANIDES WITH THE AID OF DIETHYLENETRIAMINEPENTACETIC AND NITRILOTRIACETIC ACIDS. Chuveleva, E. A.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 12, 1799-1800(Dec 1974).

Translated from Zh. Fiz. Khim.; 48: No. 12, 3078-3081(Dec 1974).

The separation factors for curium, americium, and certain lanthanides in the presence of diethylenetriaminepentaacetic and nitrilotriacetic acids were determined by elution chromatography at 25° and 70°C. (auth)

4994 FLOTATION OF ANIONS USING CATIONIC SURFACTANTS. IV. Flotation of Molybdates, Perrhenates, and Chloroaurates from Solutions of Some Electrolytes. Charewicz, W. (Technical Univ., Warsaw). Nukleonika; 20: No. 5, 447-455 (1975).

A study of the effect of Cl^-, NO_3^-, and SO_4^{2-} ions at concentration 0.0001 to 0.05 kmol/m³ on the efficiency D, rate $\bar{\nu}$ and enrichment ratio E of flotation of perrhenate, molybdate and chloroaurate ions at concentration $5 \cdot 10^{-5}$ kmol/m³ using the cationic surfactant cetyldiethylammonium hydrochloride (CDAHC) and radioisotopes ^{99}Mo, ^{186}Re, and ^{198}Au demonstrates that under the experimental conditions even a 1000-fold excess of these anions has no complete stemming effect on the process. Only the lowering of the rate and of efficiency is observed, while the enrichment ratio in most cases grows with increase of the introduced electrolytes concentration. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstract 6711.

4995 FLASH PHOTOLYSIS OF $F_2 + D_2 + O_2 + He$ MIXTURES. Vasil'ev, G. K.; Vizhin, V. V.; Makarov, E. F.; Chernyshev, Yu. A.; Tal'roze, V. L. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 129-133(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 154-159(1975).

Flash photolysis and kinetic spectroscopy were used to investigate the $F_2 + D_2$ reaction in the presence of O_2 and He. It was found that, depending on the initial conditions, the reaction initiated by the light flash occurs in two regimes: (1) with low conversion of the reactants; (2) with total conversion of the reactants in a time comparable with the characteristic time of the light flash, i.e., in the explosion regime. The critical condition for explosion was found, together with the values $k_3^{He} = (2.0 \pm 0.6) \cdot 10^{-32} cm^6/molecule^2 \cdot sec$ and $k_3^{He}/E_2 k_2^0 = (2.3 \pm 0.7) cm^3/cal$, where k_3^{He} is the rate constant for the chain termination process $D + O_2 + He \rightarrow DO_2 + He$, and E_2, k_2^0 are, respectively, the activation energy and rate constant for the chain propagation reaction $D + F_2 \rightarrow DF + F$. (auth)

4996 THERMODYNAMIC PROPERTIES OF THE CHLORIDE AND FLUORIDE SALTS OF ZIRCONIUM AND HAFNIUM DISSOLVED IN MOLTEN SALT SOLVENTS. Megy, J. A. Corvallis, OR; Oregon State Univ. (1975). 169p. University Microfilms Order No. 75-21,302.

Thesis (Ph. D.).

Zirconium and hafnium, which invariably exist together in

nature, are separated commercially by an aqueous–organic, liquid–liquid countercurrent extraction in order to provide pure zirconium for use in nuclear reactors. The anhydrous chemistry of zirconium and hafnium was studied to provide background for the development of an anhydrous process for the separation of these very similar elements. Accurate thermodynamic tables for hafnium(IV) fluorides, chlorides, and oxides, were developed. The existing electrochemical, vapor pressure, and calorimetric studies of zirconium and hafnium chlorides and fluorides complexed with alkali chloride and(or) fluoride salts were reviewed and analyzed for consistency. An experimental study of the oxidation–reduction equilibrium of zirconium and hafnium between a molten salt phase and molten zinc phase was made. The reaction shows promise as an anhydrous process for separating zirconium and hafnium. The rate of approach to chemical equilibrium was studied in a baffled stirred batch reactor. The equilibration rate was found to be mass transfer controlled. The mass transfer rate could be calculated approximately from the physical properties of the molten metal and salt phases, using the Lewis correlation, which was developed empirically from data taken from low temperature aqueous-organic systems. (Diss. Abstr. Int., B)

4997 MELTING PARAMETERS OF METHANE AND NITROGEN FROM 0 TO 10 KBAR. Cheng, V. M. (Lafayette College, Easton, PA); Daniels, W. B.; Crawford, R. K. Phys. Rev. Lett.; 11: No. 10, 3972-3975(15 May 1975).

Fluid and solid molar volume and pressure-temperature melting data were obtained at pressures up to 10 kbar for nitrogen and methane. These results were combined with data from the literature to derive molar volumes of the solids at their respective triple points, and the resulting complete data sets are represented by fitted empirical equations. (auth)

4998 SINGULARITIES OF THE HEAT AND MASS TRANSFER DURING TURBULENT FLOW IN TUBES OF THE CHEMICALLY REACTING SYSTEM N_2O_4 REVERSIBLE $2NO_2$ REVERSIBLE $2NO + O_2$. Nesterenko, V. B.; Petrovich, V. Yu.; Tverkovkin, B. E.; Zubtsova, S. A.; Tushin, N. N. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 126-132(1974). (In Russian).

Results of heat and mass transfer for turbulent flow of chemical reacting gas N_2O_4 in circular tube, both for uniform and variable properties, are offered. The research was made with modified mathematical models. The presented mathematical method allows computing time to be decreased. (auth)

Isotope Effects

4999 TRANSITION STATE STRUCTURE FOR PERACID EPOXIDATION. Secondary Deuterium Isotope Effects. Hanzlik, R. P.; Shearer, G. O. (Univ. of Kansas, Lawrence). J. Am. Chem. Soc.; 97: No. 18, 5231-5237(3 Sep 1975).

Kinetic deuterium isotope effects were measured for the epoxidation of p-phenylstyrene (3) and three deuterated derivatives (alpha-d (4); beta,beta-d_2 (5); alpha,beta,beta-d_3 (6)) with m-chloroperbenzoic acid in 1,2-dicloroethane at 0°. The isotope effects (k/sub H//k/sub D/) observed for 4, 5, and 6 are 0.99, 0.82, and 0.82, respectively; for p-nitrostyrene and its alpha-d analog k/sub H//k/sub D/ at 25° was 0.98. The peracid isotope effect for epoxidation of 3 with m-ClC_6H_4COOOH(D) at 0° was k/sub H//k /sub D/ equals 1.17. These data suggest that in the transition state for epoxidation there is substantial C/sub beta/–O bond formation, but negligible change in the bonding or hybridization at C/sub alpha/ of the olefin. Epoxidation mechanisms suggested previously cannot accommodate these findings, thus an alternate transition state structure has been proposed. It is characterized by (1) sp^2 geometry and partial positive charge at C/sub alpha/ of the olefin, (2) extensive C/sub beta/–O bond formation but with retention of some pi bonding between C/sub alpha/ and C/sub beta/, (3) a nearly equal amount of partial negative charge on the peracid carboxylate, and (4) little change in the bonding of the peracid proton. (auth)

5000 STRUCTURE OF LIQUID WATER. III. Thermodynamic Properties of Liquid Deuterium Oxide. Owicki, J. C.; Lentz, B. R.; Hagler, A. T.; Scheraga, H. A. (Cornell Univ., Ithaca, NY). J. Phys. Chem.; 79: No. 22, 2352-2361(23 Oct 1975).

A statistical thermodynamic treatment of a cluster model for liquid water was adapted to D_2O. When compared with the results of the theory for H_2O, the principal thermodynamic quantities for D_2O were fit with slightly less accuracy, but the signs of the isotopic differences in these quantities are predicted correctly. The intermolecular vibrational spectral density of D_2O was calculated (as a function of temperature) from the normal mode vibrational frequencies of the clusters and the distribution of cluster sizes. The theory indicates the occurrence of only very few clusters containing more than six molecules, the same conclusion reached for H_2O. Also, the fraction of loosely bonded noncyclic clusters of D_2O increases with increasing temperature, as was found for H_2O. The results suggest that the energy required to break hydrogen bonds in liquid D_2O may be smaller than that for liquid H_2O. The similarities between the theoretical equilibrium cluster distributions and fractions of unbroken hydrogen bonds for D_2O and H_2O imply that these liquids are structurally quite similar. Most of the thermodynamic differences between liquid D_2O and H_2O are attributable to isotopic effects on the intra- and intermolecular vibrational frequencies of the water clusters rather than to differences in the structures of the two liquids. (auth)

5001 SILVER OXIDE OXIDATION OF AN ALDEHYDE WITH CARBON TRITIUM BONDS VICINAL TO THE CARBONYL CARBON. Meloche, H. P.; Monti, C. T. (Inst. for Cancer Research, Philadelphia). Anal. Biochem.; 68: No. 1, 316-320(Sep 1975).

The NH_4OH-dependent silver oxide oxidation of D,L-[3-$^3H_2$] malate semialdehyde-4-al to D,L-[3-$^3H_2$] malate was studied. A method is presented allowing carboxylate formation immediately subsequent to aldehyde generation by periodate cleavage. It was found that at high concentrations of Ag_2O, base-catalyzed detritiation of the semialdehyde is minimal, ranging 0.5 infinity. The yield of malate appears to be quantitative. Thus, this method allows oxidation of an aldehyde to its carboxylate in high yield while preserving the configuration of the adjacent carbon atom. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 5651 – 5654.

5002 (KFK-2146) RAPID ELECTROMAGNETIC MASS SEPARATIONS WITH INTERNAL CHLORINATION FOR PREPARING SOURCES OF RARE EARTH ISOTOPES WITH HALF-LIFES $T_{\frac{1}{2}}$ GREATER THAN OR EQUAL TO 1 MIN. Feurer, B.; Hanser, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Jul 1975. 17p. (In German). Dep. NTIS (US Sales Only) $4.50.

The rapid preparation of sources of short-lived rare earth nuclides including electromagnetic mass separation with internal chlorination is described. To produce the radioactive nuclides, oxide powder targets are irradiated with the external cyclotron beam outside of the vacuum system of the beam line. Within 30 seconds the irradiated powder is transported to the mass separator, filled into the oven of the ion source, and locked into the ion source. The starting phase of ion source operation immediately following takes about 35 seconds until the ion beam current reaches 50% of its maximum value. This time, which is very short when an ion source with internal chlorination is used, is achieved by an initial CCl_4-burst and a high material flux through the ion source. Thus, the preparation of the mass separated sources needs after the end of the irradiation only about 65 seconds plus 1.5 half-lives of the nuclide of interest (optimum collection time). The method is demonstrated by studies on the decay of ^{143}Gd (1.8 min). (auth)

5003 (UCRL-Trans-10948) DISTRIBUTION OF STABLE ISOTOPES ALONG AN INFINITELY LONG SEPARATION TUBE WITH AN INFINITELY LARGE RESERVOIR AT THE END, IN THE STATIONARY CONDITION. Lyubimov, V. N. Translated from Isotopenpraxis; 11: No. 1, 25-29(1975). 15p. Dep. NTIS $4.50.

Using the computer, curves of the distribution of concentrations of isotopes of 17 elements in the stationary condition along an infinitely long separation tube with an infinitely large reservoir at the end were calculated. Distribution curves are presented for polyisotopic elements. Extreme points of the curves are compared. The character of the distribution curves is determined primarily by the initial isotope composition of the element being separated. (auth)

5004 BENZAMIDE OXYGEN EXCHANGE CONCURRENT WITH ACID HYDROLYSIS. McClellan, R. A. (Univ. of Toronto). J. Am. Chem. Soc.; 97: No. 18, 5281-5282(3 Sep 1975).

Oxygen-16–oxygen-18 exchange was used to study the acid-catalyzed hydrolysis of benzamide and the accompanying carbonyl oxygen exchange concurrent with the hydrolysis. The amount of exchange observed is small, but the observation establishes that a tetrahedral intermediate is formed during the reaction. (JGB)

5005 NUCLEAR CHEMICAL ENGINEERING. Axtmann, R. C. (Princeton Univ., NJ). Nucl. Technol.; 27: No. 1, 78-83 (Sep 1975).

Chemical engineers comprise a significant segment within the

U. S. nuclear industry, yet few study nuclear subjects before they begin their careers. Nuclear chemical engineering is defined, then, as an arena for action rather than a field of knowledge. Of the classical problem areas in nuclear chemical engineering, fuel fabrication and isotope separation have made the best recent progress. Radiation chemical engineering, once an activity of ebullient promise, is nearly moribund. Only rarely do chemical engineers approach the central locus of reactor design; when they do the results are often ambivalent or worse. Surprisingly, perhaps, chemical engineering has made several important contributions to elementary particle physics. Fusion technology presents many challenges for creative chemical engineering, e.g., in fuel recovery, gaseous permeation, and the materials effects that result from ionic bombardment. (auth)

Feed Materials Processing

5006 (AAEC/E-344) DEVELOPMENT OF PROCESSES FOR PILOT PLANT PRODUCTION OF PURIFIED URANYL NITRATE SOLUTIONS. Alfredson, P. G.; Charlton, B. G.; Ryan, R. K.; Vilkaitis, V. K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Physics Div.). Jan 1975. 38p. Dep. NTIS (US Sales Only) $5.00.

Nuclear purity uranyl nitrate solutions were produced from Rum Jungle yellow cake by dissolution in nitric acid and purification by solvent extraction with 20 vol.% tributyl phosphate in kerosene using pump-mix mixer-settler contactors. The design of the equipment, experimental studies, and operating experience are described. Dissolution of yellow cake and recycled uranium oxide materials was readily carried out in a 100 l dissolver to give solutions containing 300 gU l^{-1} and 0.5 to 4 M nitric acid. Filtration of silica from this solution prior to solvent extraction was not necessary in this work for yellow cake containing 0.25% silica. A low acid flowsheet for uranium purification was developed in which the nitric acid consumption was reduced by 76% and the throughput of the mixer-settler units was increased by 67% compared with the initial design flowsheet. Nine extraction and seven scrubbing stages were used with a feed solution containing 300 gU l^{-1} and 1.0 M nitric acid and with a portion of the product recycled as scrub solution. The loaded organic phase was stripped in 16 stages with 0.05 M nitric acid heated to 60° C to give a 120 gU l^{-1} product. The uranium concentration in the raffinate was < 0.04 g l^{-1}, corresponding to ~ 0.01% of the feed. (auth)

5007 YELLOW CAKE DEMAND FOR A NUCLEAR POWER INSTALLATION PROGRAM IN MEXICO: CONCENTRATE PRODUCTION AND COST. Medrano-Delgado, C. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 29-30(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5008 HEAP LEACHING OF EL NOPAL ORE. Ajuria-Garza, S.; Jamrack, W. D.; Guerrero, S. P.; Perez, B. B. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 30-31(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Radiation Chemistry

Refer also to abstracts 5040 and 5105.

5009 (COO-1763-48) PULSE RADIOLYSIS STUDIES OF FAST REACTIONS IN MOLECULAR SYSTEMS. Progress Report, November 1974--October 1975. Dorfman, L. M. (Ohio State Univ. Research Foundation, Columbus (USA)). 1975. Contract AT(11-1)-1763. 8p. Dep. NTIS $4.50.

Work on the reactivity of aryl carbonium ions in solution and single heme reduction in human methemoglobin is summarized.(LK)

5010 (COO-3238-534) QUARTERLY REPORT, APRIL 1, 1975--JUNE 30, 1975. (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 3 Jul 1975. Contract AT(11-1)-3238. 22p. Dep. NTIS $4.50.

Status of the following studies is given: ESR study of dissociation of NH protons of peptide radicals; electron transfer from ascorbate anion to phenoxyl radicals; dehydrohalogenation of halophenols by OH; reaction of OH radicals with nitroheterocyclic compounds; pulse radiolysis studies of the oxidation of N,N-dimethylaniline in aqueous solution; pulse radiolysis studies of some reactions of bromine dioxide in aqueous solutions; and application of radio-liquid chromatography to the radiolysis of aqueous benzene solutions. Abstracts of reports published during the quarter ending June 30, 1975 are included. (LK)

5011 (LA-6055-MS) CHEMISTRY COMPUTATIONS FOR IRRADIATED HOT AIR. Sutherland, C. D.; Zinn, J. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. 58p. Dep. NTIS $5.45.

A description is given of a computational model of chemical kinetics in air at temperatures between 300 and 4000°K, with and without imposed fluxes of ionizing radiation and uv radiation, at pressures up to 10 atmospheres. Included are 1360 chemical reactions, involving 71 H, C, N, and O-containing chemical species. The reaction set is complete in the sense of including a reverse reaction for every reaction and including the dominant destruction reactions for each species produced. Photochemical reaction rates are computed in terms of a prescribed intensity and spectral distribution of radiant flux. Reactions of the metastable species $O(^1D)$, $N(^2D)$, $O_2(^1DELTAg)$, and $O_2(^1SIGMA^+/sub\ g/)$ are included explicitly, but all other quantum state populations are assumed to be in thermodynamic equilibrium. Results of several sets of model computations are described. These include: computations of rates of equilibration of systems subjected to abrupt temperature changes at a pressure of 1 atmosphere; computations of relaxation of systems subjected to impulsive sources of ionizing radiation at P equals 1 atmosphere and 0.01 atm, with and without superimposed sources of optical-uv radiation; and computations of the approach to steady state in systems subjected to steady sources of ionizing radiation, for pressures between 10^{-3} atm and 10 atm. For computing concentrations of electrons, ions, NO, NO_2, O, N, and O_3, an abbreviated lumped-parameter reaction set was constructed with 31 reactions, designed to be incorporated in a fluid-dynamics code. Rate coefficients were calibrated against results from the 1360-reaction code for temperatures between 300 and 4000°K and pressures between 10^{-3} and 10 atm. (auth)

5012 (ORO-4183-22) CHEMICAL EFFECTS OF IONIZING RADIATIONS ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES. Comprehensive and Renewal Report. Friedberg, F. (Howard Univ., Washington, D. C. (USA)). 1975. Contract AT(40-1)-4183. 10p. Dep. NTIS $4.50.

Status of the following studies is reported: effect of gamma radiation on polypeptides, ribonuclease, solid ribonuclease, polyamino acids in the solid state, solid ATP creatine phosphotransferase and gelatin, lyophilized proteins, solid proteins; acetic and proprionic acid production from gamma irradiated dry proteins; covalent binding of amino acids to proteins due to gamma irradiation; effects of metal ions on the formation of chain breaks and radicals in gamma irradiated collagen and polyadenylic acid; and sensitivity of gelatin and albumin to irradiation at 230 nm. (LC)

5013 PULSE RADIOLYTIC INVESTIGATION OF THE SO_2^- RADICAL ION. Eriksen, T. E. (Royal Inst. of Tech., Stockholm). Radiochem. Radioanal. Lett.; 22: No. 1, 33-40(30 Jun 1975).

Aqueous solutions of sulfur dioxide in the presence of 1M formic acid/formate ion in the pH range 2-6 were pulse irradiated. The data presented indicate that SO_2^- is formed by the charge-transfer reaction $CO_2^- + SO_2 \rightarrow SO_2^- + CO_2$, $k = (7.6 \pm 1) \times 10^8\ s^{-1} \cdot SO_2^-$ recombine to form S_2O_4 with rate constant $2k = (2.2 \pm 0.3) \times 10^9\ M^{-1}\ s^{-1}$ (at $\mu \sim 1$). (auth)

5014 MECHANISM OF RADIATION CHEMICAL FRAGMENTATION OF METHYLCYCLOPENTANE. Keszei, C.; Wojnarovits, L.; Foldiak, G. (Inst. of Isotopes, Budapest). Radiochem. Radioanal. Lett.; 22: No. 1, 41-48(30 Jun 1975).

Most of the hydrocarbon fragments produced in the γ-radiolysis of methylcyclopentane labelled with ^{14}C in its methyl group are unsaturated compounds: they are produced predominantly in monomolecular reactions from methylcyclopentane molecules and its reactive intermediates. Bimolecular reactions, however, are of decisive importance in the formation of alkanes. About 80% of the breakdown processes of the five-membered ring give fragments with 2 or 3 carbon atoms but the elimination of a $\dot{C}H_2$ species, or, analogously of a CH_2-$\dot{C}H$ species if the breakdown takes place in the vicinity of the tertiary carbon atom, from the ring has also been verified. Whereas the former intermediate gives inactive methane the latter gives radioactive ethylene. (auth)

5015 OPTICAL PROPERTIES OF SOLVATED ELECTRONS IN MIXTURES OF WATER AND HEXAMETHYLPHOSPHORIC TRIAMIDE. Mal'tsev, E. I.; Koulkes-Pujo, A. M.; Vannikov, A. V.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 168-169(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 189-190(1975).

The short-lived optical absorption spectra of e^-_{solv} were studied by the pulse radiolysis technique on a U-12 accelerator. An absorption spectrum was observed having one maximum, the position of which depended on the component concentrations. (LK)

5016 TELOMERIZATION OF ETHYLENE WITH BUTYRIC AND CAPROIC ACIDS INDUCED BY GAMMA-RAYS. Grinevich,

I. A.; Zagorets, P. A.; Shostenko, A. G.; Dodonov, A. M.; Myshkin, V. E. (Moscow Chemical Technology Inst.). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 145-146(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 172-173(1975).

In radiation-induced reactions with ethylene, butyric and caproic acids formed, by 1,5-rearrangement, the corresponding series γ-ethyl-α-butylcarboxylic or α,α-dibutylcarboxylic acids. (LK)

5017 RADIATION-INITIATED ALDOL CONDENSATION IN AQUEOUS FORMALDEHYDE SOLUTIONS. Gorbachev, V. M.; Kalyazin, E. P.; Kovalev, G. V.; Petryaev, E. P. (Belorussian State Univ., Minsk). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 143-144(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 171-172(1975).

Deaerated aqueous solutions of formaldehyde at concentrations from 0.1 to 11.3M were irradiated with ^{137}Cs gamma rays. Doses of 1.2×10^{18} to 2×10^{20}eV/ml were given at a rate of 4.1×10^{15}eV/ml·sec. The results from this study indicate that an aldol condensation reaction can occur via a radical mechanism during the irradiation of aqueous solutions of formaldehyde. (LK)

5018 PULSE RADIOLYSIS OF CONCENTRATED AQUEOUS SOLUTIONS OF LITHIUM CHLORIDE. Zhestkova, T. P.; Pikaev, A. K. (Physical Chemistry Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 138-142(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 165-170(1975).

An investigation of the radiolytic conversions in concentrated aqueous solutions of LiCl (up to ~14 M) was carried out using the microsecond pulse radiolysis method with optical recording of the short-lived absorption produced on irradiation. The dependence of the Cl_2^- yield on the solution concentration was studied, and an explanation given for the observed concentration dependence. Measurements of $G(e_{aq}^-)$ in deaerated aqueous LiCl solutions in the 0.5-2.0 M range showed that the yield is almost independent of the concentration and equals 2.6-2.7 particles/100 eV. (auth)

5019 EFFECT OF HIGH PRESSURES ON THE FORMATION OF FREE RADICALS IN THE RADIOLYSIS OF POLYMERS. Kiryukhin, V. P.; Klinshpont, E. R.; Millinchuk, V. K. (Physical Chemistry Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 134-137(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 160-164(1975).

The effect of pressures of ~1.5 and 10.0 kbar on free radical formation during the radiolysis of polyethylene, polypropylene, and polytetrafluoroethylene was investigated. In PTFE and PP the free radical concentration is decreased by about 1.3-1.9 times. This is explained by an increase in the "cage" effect for free radicals formed by the rupture of C-C bonds in the main polymer chain. (auth)

5020 ESR STUDY OF THE POST-IRRADIATION CHLORINATION OF POLYPROPYLENE. Levitskii, M. B.; Dzhagatspanyan, R. V. High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 164-165(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 187(1975).

The ESR method was used previously to show that the post-irradiation chlorination of polyethylene (PE) is initiated by radicals stabilized in gamma irradiated PE. This post-effect has the following peculiarity: the concentration of radicals initiating the chain chlorination reaction decreases to a certain limit, the value of this limit and the rate of radical decay being proportional to the radiation dose. In order to determine whether the presence of a post-effect is characteristic of the radiation-induced chlorination of other polyolifins, the post-irradiation chlorination of polypropylene (PP) was investigated. Samples of isotactic PP were evacuated to 10^{-5} torr at 350°K and irradiated with ^{60}Co γ-rays at 77°C to a dose of 10 Mrad. The chlorination process of PP is similar to PE; however, some differences are that the radical decay process in PP goes further and at a higher rate, while chlorination is more extensive in PE. (LK)

5021 RADIOLYSIS OF SOLUTIONS OF IODINE IN CCl_4 SATURATED WITH AIR. Barkova, T. N.; Bulgakova, G. P.; Dmitrieva, G. V.; Myasoedova, T. G.; Zagorets, P. A. (Moscow Chemical Tech. Inst.). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 158-159(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 183-184(1975).

Iodine accumulating in the organic phase plays a deleterious part in the extractive treatment of nuclear fuel. In order to free the organic solutions from iodine compounds it is necessary to have information about the radiation-chemical transformations of I_2. The first stage of such an investigation for extraction systems with a noncombustible diluent is reported. The radiolysis of I_2 (2×10^{-2}M) in CCl_4 over a wide range of doses (up to 3.5×10^{21} eV/cm^3) was investigated. The results show that the final form in which iodine occurs when irradiated in CCl_4 solution in the presence of sufficient air is I_2O_5. (LK)

5022 RADICAL TRANSFORMATIONS IN γ-IRRADIATED FROZEN SOLUTIONS OF N-BROMOETHYLENIMINE. Dzantiev, B. G.; Koritskii, A. T.; Kostyanovskii, R. G.; Rumyantsev, Yu. M.; Shishkov, A. V. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 155-157(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 180-182(1975).

Results are given of an investigation of radicals formed by the gamma irradiation of solutions of N-bromoethylenimine frozen at the temperature of liquid nitrogen. Well resolved ESR spectra obtained make it possible to follow in greater detail the radical transformations occurring on exposure to light. (LK)

5023 INTERCONVERSION OF COMPONENTS IN THE HIGH-TEMPERATURE RADIOLYSIS OF CH_2O-CH_3OH MIXTURES. Mironov, V. P.; Kudryashov, V. P.; Kalyazin, E. P.; Petryaev, E. P.; Korolev, V. M. (Inst. of Nuclear Energetics, Minsk). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 153-154(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 179-180(1975).

Carbonyl compounds can be reduced to alcohols on exposure to radiation, the yield of the alcohol rising significantly on increasing the temperature. Deaerated binary mixtures of $CH_3OH + {}^{14}CH_2O$ and $^{14}CH_3OH + CH_2O$ were exposed to ^{60}Co gamma radiation to study the kinetics of the radiolysis. One possible mechanism is given. (LK)

5024 RADIATION-CHEMICAL YIELDS OF MOLECULAR HYDROGEN IN AQUEOUS H_2O_2 SOLUTIONS, AND THE NATURE OF ITS PRECURSORS. Nichiporov, F. G.; Byakov, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 151-152(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 177-179(1975).

A study was made of the dependence of hydrogen yields on the concentration of H_2O_2 in neutral and acidic solutions exposed to ^{60}Co gamma rays. From the experimental results it is evident that the hydrogen yields are practically identical in neutral and acid media. (LK)

5025 INFLUENCE OF WOOD EXTRACTIVES IN THE POLYMERIZATION OF METHYL METHACRYLATE BY GAMMA IRRADIATION. Burillo de V, G.; Loyola V, V. M.; Albarran S, G.; Candelas J. (UNAM, Mexico City). J. Radiat. Curing; 2: No. 3, 2-6(Jul 1975).

Those materials that can be extracted from pine or oak by ether, ethanol, methyl methacrylate (MMA), or benzene-alcohol all act as inhibitors in the gamma polymerization of MMA-wood composites. It was found that preirradiation of either the wood or of the wood-monomer combination reduces or eliminates the inhibitory effect. The most practical industrial solution to this problem is to increase the dose, thereby achieving high molecular polymer in the composite. However, the presence of a maximum in the molecular weight-dose curves means that each wood-monomer pair may have a different optimum dose. (auth)

5026 ONE-ELECTRON REDOX POTENTIALS OF NITRO COMPOUNDS AND RADIOSENSITIZERS. Correlation with Spin Densities of Their Radical Anions. Meisel, D.; Neta, P. (Carnegie-Mellon Univ., Pittsburgh). J. Am. Chem. Soc.; 97: No. 18, 5198-5203(3 Sep 1975).

One-electron redox potentials for ten nitroaromatic and nitroheterocyclic compounds were determined using the pulse radiolysis technique. These potentials were calculated from experimentally determined equilibrium constants of the electron transfer reaction between a reference semiquinone and the nitro compound. The one-electron half-cell reductions of duroquinone and 9,10-anthraquinone-2-sulfonate were used as references. The redox potentials determined in this study lie in the range of $E\frac{1}{7} = -0.19$ V for 4-nitropyridine and $E\frac{1}{7} = -0.54$ V for 2-methyl-5-nitroimidazole at pH 7 (relative to NHE). These one-electron redox potentials were shown to correlate linearly with the spin densities on the nitro groups of their radical anions determined from ESR measurements. It was found that the higher the spin density on the nitro group the more negative is the redox potential. The quantitative correlation enables a reasonable prediction of the redox potential of any nitro compound to be made from the nitrogen ESR hyperfine constant of its radical anion. Some nitro compounds are known to be efficient radiosensitizers, and it is shown here that their efficiency may be qualitatively correlated with their redox potentials with sensitizers of higher redox potentials generally being found to be more efficient. (auth)

5027 INITIATION OF THE OXIDATION REACTION OF PARAFFIN WITH MOLECULAR OXYGEN BY PRELIMINARY IRRADIATION. Drimus, I.; Florescu, C. (Polytechnic Inst., Bucharest). Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucur.; 36: No. 3, 19-26(1974). (In Rumanian).

Problems in connection with the thermal, thermocatalytic,

chemical, photochemical, and radiochemical initiation of the oxidation reaction of some pure and commercial N-paraffins with 12 to 35 C atoms in the molecule were discussed. The mass necessary for initiation was considered. The effects of a preliminary irradiation with uv, γ rays, or ultrasonics were determined experimentally. A mechanism was proposed for the radioinduced initiation of the oxidation reaction. (tr-auth)

5028 MECHANISM OF γ RADIOLYSIS OF SEWAGE. Dyubchenko, L. V.; Kovalevskaya, A. M.; Maiboroda, V. D.; Petryaev, E. P.; Shlyk, V. G. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 38-41(1974). (In Russian).

The radiolysis of pure neutral water (I) and the solution of black lye (II), used as a model of waste water, was investigated. The radiation chemical yields for (I) are: $G(-O_2) = 0.5 \pm 0.1$, $G(H_2O_2) = 1.1 \pm 0.1$; for (II) the values are: $G(-O_2) = 1.3 \pm 0.1$, $G(H_2O_2) = 0$. It is supposed, that the reaction $O_{2aq}^- + OH \rightarrow O_2 + OH^-$ bears substantially on the $G(-O_2)$ value for (I). It is pointed out, that the changes in $G(-O_2)$ values from 1.3 to 3.5 are dependent on the nature of impurities present in water. (auth)

5029 EQUILIBRIUM CONCENTRATION OF THE MOLECULAR PRODUCTS OF THE STEADY-STATE RADIOLYSIS OF WATER. Maiboroda, V. D.; Petryaev, E. P.; Byakov, V. M. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 34-37(1974). (In Russian).

Radical mechanism of water radiolysis including the reaction $O_{2aq}^- + H_2O_2 \rightarrow O_2 + OH + OH^-$ satisfactorily describes the experimental data on equilibrium concentrations of molecular products of water decomposition from the data obtained by the steady state method. The initial yields of radical and molecular products of water radiolysis and rate constants of chemical reactions were those commonly used. However it must be assumed that k_1 is 560 $m^{-1} \cdot sec^{-1}$, the value being different from that calculated in our previous paper. (auth)

5030 SYNTHESIS AND gamma-IRRADIATION OF VERBENONE AND VERBENOL. Kulesza, J.; Tsankova, E.; Gora, J. (Technical Univ., Lodz, Poland). An. Acad. Bras. Cienc.; 44: 408-411(1972).

Verbenone and verbenol which can be obtained by catalytic oxidation of alpha-pinene, are very useful for the perfumery industry. They can be used directly in perfume compositions or for the production of a number of other perfumery synthetics. The authors have attempted to transform verbenol and verbenone into other compounds by gamma irradiation. It was found, that verbenone exhibits resistance to the gamma irradiation and even at the doses of 500 Mrad it was only with small yield transformed in chrysantenone. The gamma irradiation of cis and trans verbenol by the doses of 220 Mrad has showed no change in the case of trans isomer, and on the other hand the cis isomer was transformed mainly into trans verbenol and verbenone. The results of the investigation of the conditions having influence on the yield and the composition of the reaction products in the process of the catalytic oxidizing of alpha-pinene are given. (auth)

5031 RADIATION EFFECTS ON THE OPERATING PROPERTIES OF OILS CONTAINING VISCOUS AND ANTIWEAR ADDITIVES. Kichkin, G. I.; Zaskal'ko, P. P.; Lakhshi, V. L.; Salamatov, I. I.; Dolgov, V. M.; Kolesov, A. S.; Kavkhuta, G. A. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 30-33(1974). (In Russian).

Gamma radiation effects on viscous and antiwear additives were studied. Influences on the antiwear additives effectiveness were observed. In the case of additives OTP and L3-318 the antiwear effectiveness increases, while with additives L3-309 and TKF it decreases. (auth)

5032 EFFECT OF DIFFUSION ON RATES AND MOLECULAR WEIGHTS IN GRAFT POLYMERIZATION. Odian, G.; Henry, R.; Koenig, R.; Mangaraj, D.; Trung, L. D.; Chao, B.; Derman, A. (City Univ. of New York, Staten Island, NY). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 3, 623-643(Mar 1975).

A theoretical analysis has been made of the graft polymerization process in terms of the quantitative interrelationship between the initiation rate R/sub i/, the k/sub p//k/sub t/sup 1/2/ ratio of the monomer, the equilibrium solubility M of the monomer in the polymer, the polymer film thickness L, and the diffusivity D of the monomer in the polymer. It is shown how the values of these parameters in any grafting system interact to lead to diffusion-controlled graft polymerization. Whether graft polymerization is diffusion-free or diffusion-controlled depends on the values of R/sub i/, D, k/sub p//k/sub t/sup 1/2/, and L as gathered in the parameter A equals [(k/sub p//k/sub t/sup 1/2/)(R/sub i/sup 1/2//D)]/sup 1/2//L/2. When the values of the various terms are such that A is less than 0.1 (i.e., D is large while R/sub i/, k/sub p//k/sub t/sup 1/2/, and L are small), the reaction is diffusion-free. When A is greater than 3 (i.e., D is small while R/sub i/, k/sub p//k/sub t/sup 1/2/, and L are large), the reaction is diffusion-controlled. The derived equations showing the relationship between kinetic and diffusional parameters are theoretically applicable to all grafting systems, i.e., for all monomer-polymer combinations under all conditions of reaction temperature, radiation intensity and polymer film thickness. The theoretical analysis has been verified for the rate and degree of polymerization for the radiation-induced graft polymerization of styrene to polyethylene. (auth)

5033 ESTIMATION OF THE PURITY OF GRAFT COPOLYMERS BY THIN-LAYER CHROMATOGRAPHY. Horii, F.; Ikada, Y.; Sakurada, I. (Kyoto Univ.). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 3, 755-760(Mar 1975).

Thin-layer chromatography was applied to the graft copolymers isolated from various grafting reaction products and the purity was evaluated by comparing the chromatogram of the graft copolymer sample with that of graft copolymer-homopolymer mixtures of given mixing ratios. The graft copolymers used were produced by radiation grafting in the following combinations: PVA-styrene, PVA-methyl methacrylate, cellulose-styrene, nylon-styrene, and PET-styrene. (LK)

5034 KINETICS OF POLYMERIZATION OF DIALLYL PHTHALATE (DAP) BY GAMMA RAYS. Divakar, D. S.; Rao, K. (Bhabha Atomic Research Center, Bombay). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 2, 295-308(Feb 1975).

Diallyl o-phthalate (DAP) was polymerized by gamma radiation from a ^{60}Co source and the kinetics of polymerization were studied at several dose rates and temperatures. The results show that the rate of polymerization was proportional to $I^{0.68}$, where I is the radiation dose rate. The net activation energy of the polymerization reaction (E/sub p/-1/2E/sub t/) was 5.02 kcal/mole, where E/sub p/ and E/sub t/ are the activation energies for the propagation and termination steps, respectively. The radical yield G/sub R/ for DAP was measured by the loss of diphenyl picryl hydrazyl (DPPH) used as a radical scavenger. G/sub R/ in the solution after irradiation was 3.12. The ratio of the rate constants k^2/sub p//k/sub t/ was calculated to be 4.09×10^{-7} at 25.8°C and 15.0×10^{-7} at 55.4°C. At room temperature, the ratio of degradative chain transfer constant to k/sub p/, i.e., k/sub u//k/sub p/ was found to be 0.065 and k/sub tr//k/sub u/ as 0.032, where k/sub tr/ is the nondegradative chain-transfer constant. Molecular weights of these polymers as determined by vapor pressure osmometry showed that the degree of polymerization was between 8 and 10. Infrared spectra of the polymers indicated that intramolecular cyclization took place during polymerization. (auth)

5035 TEMPERATURE EFFECTS ON GAMMA INITIATED POLYMERIZATION OF STYRENE. III. Conversion in the Range 150 to 200°C. Taherzadeh, M.; Hodgins, J. W. (McMaster Univ., Hamilton, Ont.). J. Polymer Sci., Polym. Chem. Ed.; 13: No. 2, 425-435(Feb 1975).

Experimental data are presented for the polymerization of commercial styrene in a gamma-radiation flux of 20 to 51 rad/sec in the temperature range of 150 to 200°C. At radiation intensities above 20 rad/second, conversion rate is independent of dose rate over the range. Above 165°C, radiation does not enhance the conversion rate but does produce more rapid elimination of residual monomer. Molecular weights of polymer product in this temperature range are too low to be of commercial interest. An optimal temperature range of 110 to 120°C is suggested for the process. (auth)

5036 ACCELERATED RADIATION POLYMERIZATION OF VINYL-DIVINYL COMONOMER SYSTEMS. II. Styrene-Tetraethylene Glycol Dimethacrylate. Micko, M. M.; Pasznor, L. (Univ. of British Columbia, Vancouver). J. Radiat. Curing; 1: No. 4, 2-6(Oct 1974).

The gamma-radiation polymerization of highly resistant styrene (S) was significantly accelerated by incorporation of tetraethylene glycol dimethacrylate (TEGDMA) acting as cross-linking agent. Incorporation of small amounts of TEGDMA results in hyperbolic decrease of curing time. Half-time concentration, i.e., concentration of TEGDMA required to reduce curing time to one-half of that for pure S, is approximately 5 to 6 vol percent. The derived empirical equation, for estimation of the overall acceleration constant and prediction of curing times for different comonomer mixtures, was found to be fully applicable within a broad concentration range for S. Agreement between computed and experimentally measured curing times was within 10 percent error. Curing sensitivity at intermediate and higher cross-link densities, given by concentration of TEGDMA in the system is discussed. It is suggested that retardation of curing resulting from diffusion barriers in densly cross-linked systems is counter balanced by copolymerization effects due to advantageous monomer reactivity ratios between S and methacrylic moieties of TEGDMA. This

effect is compounded with favorable steric conditions existing on S macroradicals for mutual termination by combination rather than disproportionation. (auth)

5037 HYDROGELS FROM RADIATION CROSSLINKED BLENDS OF HYDROPHILIC POLYMERS AND FILLERS. Yen, S. N.; Osterholtz, F. D. (to Union Carbide Corp.). US Patent 3,900,378. 19 Aug 1975. Filed date 6 Nov 1972. 14p.

Particulate, free-flowing, insoluble swellable polymers are provided which are comprised of a mixture of an insoluble, swellable hydrogel and inert filler. The mixtures are free-flowing powders or granules which can absorb many times their weight of water and hence are useful as a soil amendment. (auth)

5038 NOVEL PROCESS FOR PREPARING CALCIUM SULFATE. Machi, S.; Shinano, T.; Matui, Y.; Hibi, Y. (to Japan Atomic Energy Research Inst.). US Patent 3,901,778. 26 Aug 1975. Priority date 24 Dec 1971, JA. 6p.

In a process for preparing calcium sulfate by oxidizing the system made up of calcium sulfite and water, the oxidation reaction is much accelerated by irradiation with an ionizing radiation, such as electron beam, gamma, or x radiation. When the system is kept in acidic state, the reaction is further accelerated. (auth)

5039 RADIOLYSIS OF AQUEOUS SOLUTIONS OF RIBOSE-5-PHOSPHATE. The Effect of pH. Bachman, S.; Zegota, H. (Technical Univ., Lodz, Poland). Nukleonika; 20: No. 5, 439-446(1975).

The effect of pH on the process of radiolysis of aqueous ribose-5-phosphate (R-5-P) solutions was investigated. Solutions at concentration 10^{-2} M were irradiated in the ^{60}Co γ source in the presence of N_2 over the range of doses from 0 to 1.4 Mrad. It has been found that pH of the solution affects the radiation yield of ribose-5-phosphate decomposition, G-values measured by the loss in reducing power were 3.7 for a solution of pH = 2.20 and 2.9 for neutral and alkaline solutions. Similarly, pH has been found to affect the radiation yield of the formation of inorganic phosphate (P_i), malondialdehyde and substances absorbing in ultraviolet region (λ_{max} = 263 nm). (auth)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

5040 NUCLEAR ACTIVATION OF RHENIUM CARBONYL. I. Cavin, P. A. (Inst. of Applied Radiophysics, Lausanne, Switzerland); Ianovici, E.; Milman, M. Radiochem. Radioanal. Lett.; 22: No. 1, 71-76(30 Jun 1975).

In order to investigate the isotope effect observed upon nuclear activation of $Re_2(CO)_{10}$ it was found necessary to get a deeper insight into the analytical method used and the radiochemistry involved. The comparison of two methods of analysis (sublimation and column chromatography) of neutron-irradiated rhenium carbonyl has proved the existence of a number of labile species which behave differently under given experimental conditions. The parent compound yield was found to be the same by both methods and invariable under thermal annealing conditions. (auth)

5041 CONSEQUENCES OF A CONVERTED ISOMERIC TRANSITION AT 298°K IN SURFACE ATOMS OF TIN-119m. Ablesimov, N. E.; Bondarevskii, S. I. (Inst. of Nuclear Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 147-148(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 174-175(1975).

An attempt was made to detect at room temperature the reliably recorded resonance absorption for $^{119m}Sn(IV)$ atoms sorbed on AV-16 and AV-17 anion exchangers. (LK)

5042 RADIOCHEMISTRY TEACHING AND RESEARCH AT THE UNIVERSITY OF CALIFORNIA AT IRVINE. Guinn, V. P.; Miller, G. E.; Rowland, F. S. (Univ. of California, Irvine). Nucl. Technol.; 27: No. 1, 124-130(Sep 1975).

The field of radiochemistry is emphasized considerably at the University of California at Irvine in both undergraduate and graduate courses and in senior, graduate, postdoctoral, and faculty research. Particularly strong emphasis is placed on two areas of the field of radiochemistry: neutron activation analysis (NAA) and radiotracer work. Three areas of NAA applications are especially pursued: crime investigation, environmental science, and geochemistry. Both the teaching and the research programs utilize particularly the Department of Chemistry's TRIGA research reactor and the 14-MeV neutron generator. The radioactive tracer studies are applied especially to the study of chemical kinetics, including hot-atom chemistry with in situ tracer formation and photochemistry with labeled molecules. (auth)

Properties of Radioactive Materials

Refer also to abstract 5962.

5043 (UCRL-76708) ESTIMATED VALUES OF SOME CRYOGENIC PROPERTIES OF HYDROGEN ISOTOPES. Briggs, C. K.; Hickman, R. G.; Tsugawa, R. T.; Souers, P. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Sep 1975. 11p. (CONF-751026-5). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

The literature on cryogenic hydrogen isotopes from 4.2 to 25°K is reviewed for triple points, vapor pressures, liquid viscosities, surface tensions, and liquid and solid densities. Data are extrapolated to yield values for DT. Empirical equations are given for all isotopes for each property. At the estimated 19.71°K triple point of 1 : 1 D-T in D_2-DT-T_2 solution, the estimated properties are: vapor pressure, 19,420 Pa (145.7 torr); viscosity 550×10^{-7} Pa/s; surface tension 4.23×10^{-3} N/m; liquid density, 0.0446×10^6 mol/m^3 (224 Kg/m^3); solid density, 0.051×10^6 mol/m^3 (256 Kg/m^3); and shrinkage upon freezing, -13 vol percent. At 4.2 K, estimated values are: vapor pressure, 2.4×10^{-10} Pa (1.8×10^{-12} Torr) and solid density, 0.053×10^6 mol/m^3 (267 Kg/m^3). (auth)

5044 (UVA-ER--001-75U) MEASUREMENT OF THE GAS DENSITY OF URANIUM HEXAFLUORIDE BY LASER RAMAN SCATTERING. Adolfson, W. F.; Schlecht, R. G.; Morton, J. B. (Virginia Univ., Charlottesville (USA). Research Labs. for the Engineering Sciences). Jul 1975. Contract E(40-1)-1779. 64p. Dep. NTIS $6.25.

This investigation demonstrates the feasibility of using laser Raman scattered light to measure the gas density of uranium hexafluoride over the pressure range 1-72 Torr. Light scattered at right angles from the laser beam is collected by a lens arrangement, analyzed with a monochromator, and recorded with a dc amplifier and photomultiplier system. A review of the pertinent concepts describing the Raman effect is presented, and the sources of background, of which dark current was the most significant, are discussed. The first fundamental vibrational frequency of UF_6 is located at 665 cm^{-1}, and had a 2.5 cm^{-1} linewidth (FWHM) and 0.024 depolarization ratio. The peak differential cross section of this line, measured relative to the 992 cm^{-1} line of benzene, is 1.2×10^{-29} +- 9 percent cm^2/mol. sr. cm^{-1}. The intensity of the scattered light remains linear over one and one-half orders of magnitude. Detection was limited in the low light levels by the detector dark current. (auth)

5045 REACTIONS OF FREE PHENYL CATIONS WITH SIMPLE ETHERS IN THE GAS PHASE. Nefedov, V. D.; Sinotova, E. N.; Korsakov, M. V.; Alekseev, E. G. (Leningrad State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 108-112 (1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 130-134(1975).

The radioactive decay of tritium incorporated in highly tritiated benzene, C_6T_6, leads to the formation of phenyl cations, $C_6T_5^+$ (I). Radioactive gas chromatography (RGC) was used to study the products of the gas-phase reactions of these ions with ethers of the general formula CH_3OR, where R is CH_3, C_2H_5, iso-C_3H_7, n-C_3H_7, and tert-C_4H_9. The labeled products are methylphenyl ether and ethers of the general formula PhOR, formed by the attack of ion I on the unshared electron pair on the oxygen atom and the subsequent splitting off of R^+, and also simple phenyl ethers, the formation of which is associated with a change in the carbon skeleton of the reacting molecules. An inverse relationship between the enthalpy of formation of R^+ and the PhOR yields was established. (auth)

5046 DYNAMICS OF THE LIGAND EXCHANGE IN URANYL BIS-CHELATED COMPLEXES. I. Fast Exchange Between Bis-(Acetylacetonato)-Uranyl and Acetylacetone Studied By NMR. Vasilescu, A. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Chim.; 20: No. 7, 951-955(Jul 1975).

The temperature dependence of the NMR spectrum of bis(acetylacetonato)-uranyl and of the free ligand in acetonitrile solution is presented. Rate constants at different temperatures were determined and an Arrhenius activation energy of 13.6 ± 1.0 kcal/mole was found. The experimental data suggest a mechanism consisting of two processes: a unimolecular and a bimolecular one. (auth)

5047 STRUCTURE OF THE HIGH TEMPERATURE MODIFICATION OF α-UMo_2O_8. Serezhkin, V. N.; Kovba, L. M.; Trunov, V. K. Sov. Radiochem.; 16: No. 2, 233-236(1974).

Translated from Radiokhimiya; 16: No. 2, 231-235(1974).

An x-ray structural investigation of monocrystals of α-UMo_2O_8

was made to validate previous literature values. Results coincided with the literature values. (LK)

5048 REDUCTION OF NEPTUNIUM AND IRON BY THIOUREA DIOXIDE. Mefod'eva, M. P. Sov. Radiochem.; 16: No. 2, 194-196(1974).

Translated from Radiokhimiya; 16: No. 2, 193-196(1974).

A study was made of the reduction of neptunium(V) and iron(III) by thiourea dioxide in nitric acid solutions. It was established that the reaction of neptunium(V) with the reducing agent proceeds by a complex mechanism. In the range of HNO_3 concentration from 0.25 to 6 M in the presence of excess reducing agent at 40-50°C in air the reaction is complete in 20-40 min with the conversion of 80-85% of the neptunium into the tetravalent form. In an inert atmosphere the reduction proceeds to the conversion of a considerable part of the neptunium into the trivalent form. Iron(III) is reduced quantitatively by thiourea dioxide in 0.1-1 M HNO_3 with heating (40-50°) by a first-order reaction with respect to the metal and the reducing agent. The activation energy of the reaction in 0.5 M HNO_3 with $C(NH_2)_2CSO_2 = 8.75 \cdot 10^{-2}$ M was found to be 30.8 kcal/mole. (auth)

5049 OXIDATION OF PLUTONIUM(III) BY PERSULFATE IONS. Shilov, V. P.; Milovanov, A. I.; Krot, N. N. Sov. Radiochem.; 16: No. 2, 197-200(1974).

Translated from Radiokhimiya; 16: No. 2, 196-199(1974).

A spectrophotometric study was made of the kinetics of oxidation of Pu(III) by persulfate ions in perchloric and nitric acid solutions with $\mu = 2.6$, $[H^+] = 0.25-2.5$ g-ion/liter, and a temperature of 30-60°. It was established that in 0.5-2.5 M acid the rate if the irreversible oxidation of Pu(III) is described by an equation which is first-order with respect to the metal and the oxidant and is independent of the hydrogen ion concentration. The activation energy of the oxidation reaction was found to equal 14.5 ± 1 kcal/mole. (auth)

5050 IR SPECTROSCOPIC INVESTIGATION OF SOME COMPLEX COMPOUNDS OF URANIUM(IV) AND THORIUM. Petrzhak, G. I.; Zelentsov, S. S. Sov. Radiochem.; 16: No. 2, 201-204(1974).

Translated from Radiokhimiya; 16: No. 2, 200-203(1974).

A study was made of the IR spectra of the oxalate compounds $H_2U_2(C_2O_4)_5 \cdot 8H_2O$, $K_2U_2(C_2O_4)_5 \cdot 8H_2O$ and $H_2Th_2(C_2O_4)_5 \cdot 9H_2O$. It was shown that the compounds are complex, but the state of the oxalate groups in them is close to the state of the oxalate ion, i.e., the bonds of the oxalate groups to the uranium and thorium atoms are predominantly ionic and in the uranium compounds the oxalate groups are somewhat distorted. The IR spectrum of the complex salt $K_4U(C_2O_4) \cdot 5H_2O$ was studied. It was shown that this compound, like the thorium derivative $K_4Th(C_2O_4)_4 \cdot 4H_2O$, contains bidentate oxalate groups, which form five-membered rings with the metal. In addition, in the uranium compound there are apparently bidentate oxalate groups which form four-membered rings with the uranium of bridging oxalate groups. The bonds of the central ion with the oxalate groups in the uranium compound $K_4U(C_2O_4) \cdot 5H_2O$ are less covalent than in the analogous compound of thorium. (auth)

5051 COMPLEX FORMATION IN THE SYSTEMS URANIUM HALIDE-ALKALI METAL HALIDE: ENERGETICS OF ALKALI METAL HEXABROMOURANATES(IV). Vdovenko, V. M.; Suglobova, I. G.; Chirkst, D. E. Sov. Radiochem.; 16: No. 2, 205-209(1974).

Translated from Radiokhimiya; 16: No. 2, 203-208(1974).

The enthalpies of formation of the alkali metal hexabromouranates(IV) increase with an increase in the atomic number of the alkali metal. The observed increase in the enthalpies of formation evidently is mainly caused by the less steep fall in the crystal lattice energies in the series of compounds M_2UBr_6 from the sodium to the cesium salts in comparison with the series of alkali metal bromides, while the change in the energetics of the complex anion in the series of compounds M_2UBr_6 appears to be not too significant and makes a second-order contribution to the change in the enthalpies of formation. The enthalpies of formation and also the energy levels of the corresponding hexachloro- and hexabromouranates, calculated by the Kapustinskii-Yatsimirskii method, are very similar. (auth)

5052 THERMAL STABILITY OF URANIUM(IV) OXALATE HEXAHYDRATE. Zgirov, A. I.; Dunaeva, K. M; Khudyakova, R. R. Sov. Radiochem.; 16: No. 2, 210-213(1974).

Translated from Radiokhimiya; 16: No. 2, 208-213(1974).

The thermal decomposition of uranium(IV) oxalate hexahydrate was investigated by DTA, DTG, and IR spectral analysis. The activation energies for the separate stages of the decomposition of $U(C_2O_4)_2 \cdot 6H_2O$ were calculated by means of Kissinger's equation. The position of the lines characterizing the relation of the maximum reaction rate to the heating rate in a temperature series is proposed as a criterion of thermal stability. On the basis of the data obtained the most probable formula is proposed for uranium (IV) oxalate hexahydrate: $[UO(C_2O_4H)_2(H_2O)] \cdot 4H_2O$. (auth)

5053 THERMAL STABILITY OF URANYL OXALATE. Zhirov, A. I.; Dunaeva, K. M.; Khudyakova, R. V.; Ippolitova, E. A. Sov. Radiochem.; 16: No. 2, 214-217(1974).

Translated from Radiokhimiya; 16: No. 2, 213-217(1974).

The thermal stability of uranyl oxalate and its hydrates was studied by DTA, DTG, and TG methods. It was shown that the dehydration process proceeds in three stages and the decomposition of anhydrous uranyl oxalate in two. The kinetic parameters of the dehydration of uranyl oxalate hydrates and the decomposition of the anhydrous compound were calculated. On the basis of the data obtained the hypothesis was put forward that uranyl oxalate trihydrate is at least a "dimer" whose composition may be represented by the formula $UO_2[UO_2(C_2O_4)_2(H_2O)_2] \cdot 4H_2O$. (auth)

5054 HYDROLYSIS OF TRANSURANIUM ELEMENTS. IV. Sorption Homogeneity of Microamount of Americium(III). Korotkin, Yu. S. Sov. Radiochem.; 16: No. 2, 218-222(1974).

Translated from Radiokhimiya; 16: No. 2, 217-221(1974).

By a cation exchange method we studied the hydrolysis of americium (10^{-6} M) in solutions of pure $HClO_4$ and in the presence of the cations Li^+ and K^+. It was shown that the hydrolysis of americium begins at pH ≃ 0.4 and is a slow process. The equilibrium between the hydrolysis forms of americium, which is disrupted as a result of the ion exchange sorption, is not restored in a period of more than 20 hours. The different effects of lithium and potassium ions at low concentrations ($10^{-2}-10^{-1}$ M) on the hydrolysis of americium may be explained by the formation of outer-sphere complexes. (auth)

5055 HYDROLYSIS OF TRANSURANIUM ELEMENTS. V. Hydrolysis of Americium and Curium in Perchloric Acid Solutions. Korotkin, Yu. S. Sov. Radiochem.; 16: No. 2, 223-226 (1974).

Translated from Radiokhimiya; 16: No. 2, 221-225(1974).

A study was made of the hydrolysis of americium and curium at concentrations of $10^{-6}-10^{-4}$ M in perchloric acid solutions. The presence of several sorptionally heterogeneous forms with different charges may be explained by the formation of outer-sphere hydroxyl groups by hydrolysis of hydrated americium and curium ions. It was observed that the polymerization of hydrolysis forms of americum and curium begins with a concentration of them of 10^{-4} M. (auth)

5056 OXIDATION-REDUCTION REACTIONS OF ACTINIDE ELEMENTS. XXV. Kinetics of Neptunium(IV)-Americium(V) Reaction in Perchlorate Solutions. Blokhin, N. B.; Ermakov, V. A.; Rykov, A. G. Sov. Radiochem.; 16: No. 2, 191-193(1974).

Translated from Radiokhimiya; 16: No. 2, 189-192(1974).

A study was made of the kinetics of the neptunium(IV)-americium(V) reaction, which leads to a change in the structure of both cation-reagents, and the standard thermodynamic parameters of activation were determined. The character of the observed dependence on the reaction rate of the hydrogen ion concentration and the sign of the standard entropy of activation of the neptunium(IV)-americium(V) reaction show that over the range of experimental conditions studied this reaction has the features of oxidation-reduction of the "hole" type. (auth)

5057 IONIZATION CONSTANTS OF SOME ORGANOPHOSPHORUS ACIDS. Guseva, N. N.; Sklenskaya, E. V.; Karapet'yants, M. K.; Mikhailichenko, A. I. Sov. Radiochem.; 16: No. 2, 275-277(1974).

Translated from Radiokhimiya; 16: No. 2, 273-275(1974).

By the pH-potentiometric method we determine the ionization constants of 13 organophosphorus acids in aqueous and aqueous alcohol (75 vol. % ethyl alcohol) solutions. We established the effect on the pK_a value of the nature of the substituent radical in the acid, i.e., the length of the hydrocarbon chain, branching in the chain, and the replacement of an alkyl by an alkoxyl or aryl radical. We compared the ionization constants with the complex formation constants of the organophosphorus acids with lanthanum, ytterbium, and thorium. (auth)

5058 POSITION OF THE ACTINIDES IN THE PERIODIC TABLE. Grigorovich, V. K. Sov. Radiochem.; 16: No. 2, 140-148(1974).

Translated from Radiokhimiya; 16: No. 2, 138-148(1974).

All elements without exception, including the actinides and lanthanides, on the one hand, may be arranged in the Periodic Table in complete accord with D. I. Mendeleev's Periodic Law without

disrupting the sequence of increasing atomic numbers with one element to each group in accordance with the strict criterion of the total number of potential valence electrons in the filling shells. On the other hand, the actinides and lanthanides may be separated out as families of f-transition metals and combined as analogs in third subgroups, emphasizing their difference from the d-, s-, and p- elements and their special place in the table. Placing lanthanides and actinides in two additional series in periods 6 and 7 reflects the double periodicity of the f-elements, which is caused by the stability of the f^7-shell. Placing the actinides and lanthanides in Groups II-VIII of the Periodic Table takes into account to the maximum possible degree their known valence states in solutions, solid compounds, and metallic phases and guides investigators in the search for as yet undiscovered valence states corresponding to the electronic structure of these elements. The short Periodic Table, which shows best the similarity in the chemical properties and the valence states of elements of the different subgroups of the same group, assumes the clearest and most compact form with the actinides and lanthanides placed in the f-subgroups. (auth)

5059 REDUCTION OF URANYL ION IN NONAQUEOUS MEDIA. Belyaev, Yu. I.; Skoblo, A. I.; Suglobov, D. N. Sov. Radiochem.; 16: No. 2, 281-282(1974).

Translated from Radiokhimiya; 16: No. 2, 278-279(1974).

The reduction of the uranyl ion in an organic solution by a strong reducing agent (a solution of sodium in tetrahydrofuran in the presence of anthracene) was investigated. (LK)

5060 EFFECTIVE MAGNETIC MOMENTS OF NEPTUNIUM IONS IN SOLUTIONS. Shcherbakov, V. A.; Chaikhorskii, A. A.; Iorga, E. V. Sov. Radiochem.; 16: No. 2, 283-285(1974).

Translated from Radiokhimiya; 16: No. 2, 279-281(1974).

Determination of the effective magnetic moments (μ_N) of the ion Np(VI), Np(V), and Np(IV) through the spin-lattice relaxation times of protons in aqueous nitrate solutions indicates rapid electronic relaxation in all the ions listed and this was confirmed directly by plotting PMR spectra of aqueous and aqueous acetone solutions of neptunyl nitrate. We observed a strong dependence of the values of μ_N on the composition of the solution and this indicates interaction with the nitrate ion, which was confirmed in the case of neptunyl nitrate by means of ^{14}NMR. (auth)

5061 INVESTIGATION OF HYDRATION OF NEPTUNYL BY NMR SPECTROSCOPY. Scherbakov, V. A.; Iorga, E. V.; Mashirov, L. G. Sov. Radiochem.; 16: No. 2, 286-287(1974).

Translated from Radiokhimiya; 16: No. 2, 281-283(1974).

We plotted the temperature dependences of the PMR spectra of aqueous acetone solutions of neptunyl perchlorate with various water contents – P = 6-240. The hydration number of neptunyl calculated from the ratio of the integral intensities of the signals of free and coordinated molecules, resolution of which is observed below –65°, is 6. The paramagnetic shift in the signal A_c equals +95 ppm and is close to the calculated value on the assumption that there is a pseudocontact mechanism for the electron–nuclear interaction, the constant A/h of which equals –2.2MHz. (auth)

5062 EFFECT OF DIFFERENT FORMS OF SILICIC ACID ON SORPTION BEHAVIOR OF PROTACTINIUM. Sheidina, L. D. Sov. Radiochem.; 16: No. 2, 265-266(1974).

Translated from Radiokhimiya; 16: No. 2, 264-266(1974).

In a study of the sorption of protactinium on sorbents of different natures from solutions with pH = 2-12 in the presence of different forms of silicic acid it was shown that the α-form of silicic acid does not affect the sorption of protactinium, while the sorption of protactinium from solutions containing polymeric forms is strongly reduced. The hypothesis was put forward that the suppression of the sorption of hydroxo cations of protactinium from solutions containing polymeric forms of silicic acid is the result of the chemical interaction of protactinium with the β-form of silicic acid with the formation of complex anions. It was established that in cases where sorption processes are used for the concentration of protactinium and the solution contains polymeric forms of silicic acid, the latter must be removed beforehand to avoid considerable losses of protactinium. (auth)

5063 COPRECIPITATION OF RADON FLUORIDE WITH SOME COMPOUNDS OF XENON. Avrorin, V. V.; Nefedov, V. D.; Toropova, M. A. Sov. Radiochem.; 16: No. 2, 260-261(1974).

Translated from Radiokhimiya; 16: No. 2, 261-262(1974).

Results are given for the coprecipitation of radon fluoride with XeF_2, XeF_4, and $XeF_2 2SbF_5$. Radon fluoride was obtained by the reaction of radon with elementary fluorine, bromine pentrafluoride or with XeF_2 or XeF_4 or solutions of them in BrF_5. (LK)

5064 DEACTIVATION OF SURFACES BY SOLUTIONS IN THE ABSENCE AND IN THE PRESENCE OF A SORBENT. Shchebetkovskii, V. N.; Bochkov, A. A. Sov. Radiochem.; 16: No. 2, 254-259(1974).

Translated from Radiokhimiya; 16: No. 2, 254-260(1974).

A study was made of the deactivation of surfaces by solutions in the absence and in the presence of a sorbent and the relation of K_{des} to the solution volume and parameters characterizing the sorbent was established. It was shown that the reduction in the volume of the deactivating solution as a result of the introduction to a sorbent with the deactivation effect remaining the same may be calculated. To eliminate the unjustified increase in the consumption of cleaning compositions in deactivation it is recommended that the concept of the rational volume is used and methods of determining it are demonstated on the example of the cleaning of certain surfaces to remove ^{137}Cs and ^{239}Pu. On the discussion level we propose the definition of the deactivation capacity (power) of a surface–solution system as the rational volume per unit area of the surface treated. (auth)

5065 EFFICIENT PREPARATION OF RADIOIODINE LABELLED 3,5,3′-TRIIODOTHYRONINE AND THRYOXINE FOR MEDICAL USE. Kim, J.; Kim. T. H. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 7: No. 2, 127-133(Jun 1975).

In the isotopic exchange labelling of 3,5,3′-triiodothyronine (T_3) and thryoxine (T_4) with radioiodide in the presence of molecular iodine, T_3: I_2 or T_4: I_2 molar ratios, pH, and reaction time are considered to be important factors. A modified labelling and separation method is proposed, by which T_3-^{125}I and T_4-^{125}I can be obtained with the mean labelling yields of 45%, and 50%, respectively. The whole reaction products can be separated by the adoption of a thin-layer chromatography technique using silica gel plate and the solvent system composed of chloroform, methanol, and ammonia. (auth)

5066 RADIOISOTOPE METHOD FOR THE STUDY OF EMULSION STABILITY. Magas, S.; Kostanski, M.; Przybylska, A. (Technische Hochschule, Posnan, Poland). Isotopenpraxis; 11: No. 7, 255-259(Jul 1975). (In German).

A radioisotopic method was developed for the determination of emulsion decomposition. It is based on the introduction of the labelling isotope into one of the emulsion phases and on the registration of the displacement of this phase by measurement of the intensity changes of the γ radiation from a thin layer of this emulsion. The radioisotopes ^{125}I and ^{131}I gave satisfactory results on phase displacement or decomposition by the variation in the intensity of their γ emission. (JSR)

5067 PRODUCTION OF CHLORMERODIN-^{197}Hg AND -^{203}Hg AT THE BORIS KIDRIC INSTITUTE. I. The Production Process and the New Cell. Vanlic-Razumenic, N. M.; Durkalic, R. S.; Perovic, D. B. (Inst. of Nuclear Science, Belgrade). Isotopenpraxis; 11: No. 7, 243-245(Jul 1975).

A new cell for the production of chloromerodrin (neohydrin, promerane) was constructed. This radiopharmaceutical is produced at an activity level of 300 to 400 mCi per batch; the yield is 78 to 80%, and the specific activity 0.5 to 1.5 mCi/mg of chloromerodrin. Radiochemical purity is: organic mercury > 99%; inorganic mercury < 1%. (auth)

5068 DETERMINATION OF THE RADIOCHEMICAL PURITY OF PHOSPHORUS-32 AND TRITIUM-LABELED DIISOPROPYLPHOSPHOROFLUORIDATE (DFP). Christopher, R. E.; Sheppard, G. (Radiochemical Center, Amersham, Eng.). Anal. Biochem.; 68: No. 1, 167-174(Sep 1975).

A method is described for the determination of the radiochemical purity of labeled diisopropylphosphorofluoridate (DFP), based on the irreversible inhibition reaction with the enzyme alpha-chymotrypsin. The nature of the impurities in commercially available ^{32}P- and ^{3}H-labeled DFP is discussed. (auth)

5069 PREPARATION OF MALEIC ANHYDRIDE USING A CATALYST CONTAINING A URANYL ION. Kobylinski, T. P.; Taylor, B. W. (to Gulf Research and Development Co.). US Patent 3,907,835. 23 Sep 1975. Filed date 21 May 1973. 8p.

A process is described for converting benzene, an ethylenically unsaturated aliphatic hydrocarbon having from 4 to 5 carbon atoms per molecule and from 1 to 2 olefinic double bonds, and in which the 4 carbon atom hydrocarbon is unbranched, or a monoethylenically unsaturated straight-chain aldehyde having from 4 to 5 carbon atoms per molecule and wherein the olefinic double bond is in the beta position with respect to the carbonyl group, to maleic anhydride by catalytic oxidation in the presence of a catalyst comprising a uranyl ion, especially uranium phosphate. One preferred form of the catalyst consists of an intimate chemical admixture of vanadium, uranium, phosphorus, and oxygen in which the uranium to phosphorus mole ratio is from 0.2:1 to 2:1, the phosphorus to oxygen mole ratio is from 0.1:1 to 0.35:1; and the

vanadium to uranium atomic ratio is from 0.1:1 to 2:1. A method of preparation of the catalyst composition is also disclosed. (auth)

5070 TREATMENT OF AQUEOUS LIQUORS WITH URANYL IONS. Murchison, C. B. (to Dow Chemical Co.). US Patent 3,901,806. 26 Aug 1975. Filed data 4 Feb 1974. 4p.

Organic compounds present in an aqueous liquor are oxidized by mixing gaseous oxygen with liquor at a pH of about 3 to about 4.5 in the presence of a catalytic quantity of uranyl ions under irradiation by light ranging in wavelength from about 5800 to about 2000A. The organic materials are oxidized into CO_2, water, and lower weight organics. Cupric ions may be added to prevent the formation of a uranium-containing precipitate, which may occur during the oxidation of certain organic compounds. (auth)

Radioactive Waste Treatment

5071 (ARH-SA-240) PROCESSING OF RADIOACTIVE WASTE SOLUTIONS IN A VACUUM EVAPORATOR-CRYSTALLIZER. Petrie, J. C.; Donovan, R. L.; Van der Cook, R. E.; Christensen, W. R. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 26 Sep 1975. Contract E(45-1)-2130. 27p. (CONF-751107-12). Dep. NTIS $5.00.

From 68th annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

Results of the first 18 months' operation of Hanford's vacuum evaporator-crystallizer are reported. This process reduces the volume of radioactive waste solutions and simultaneously converts the waste to a less mobile salt cake. The evaporator-crystallizer is operating at better than design production rates and has reduced the volume of radioactive wastes by more than 15 million gallons. A process description, plant performance data, mechanical difficulties, and future operating plans are discussed. Also discussed is a computer model of the evaporator-crystallizer process. (auth)

5072 (BNWL-SA-4854) CHEMICAL DURABILITY OF GLASSES CONTAINING RADIOACTIVE FISSION PRODUCT WASTE. Mendel, J. E.; Ross, W. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1974. 18p. (CONF-740438-2). Dep. NTIS $4.50.

From annual meeting of the American Ceramic Society; Chicago, Illinois, USA (28 Apr 1974).

Measurements made to determine the chemical durability of glasses for disposal of radioactive waste are discussed. The term glass covers materials varying from true glass with only minute quantities of crystallites, such as insoluble RuO_2, to quasi glass-ceramics which are mostly crystalline. Chemical durability requirements and Soxhlet extractor leach tests are discussed. (LK)

5073 (BNWL-SA-5454) PERFORMANCE OF A WIPED FILM EVAPORATOR WITH SIMULATED HIGH LEVEL WASTE SLURRIES. Dierks, R. D.; Bonner, W. F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 20p. (CONF-751107-10). Dep. NTIS $4.00.

From 68th annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

The horizontal, reverse taper, wiped film evaporator that was evaluated demonstrated a number of positive characteristics with respect to its applicability in the solidification of nuclear fuel recovery process wastes. Foremost among these is its ability to remove the bulk (80 to 90 percent) of the liquid associated with any of the purex-type high level, intermediate level, or mixed waste slurries. The major disadvantage of the evaporator is its current inability to discharge a product that is low enough in liquid content to avoid sticking to the evaporator discharge nozzle. Also, while the indirect indications of the torque required to turn the rotor and the power drawn by the drive motor are indicative of the liquid content of the discharged product, no reliable correlation has been found to cover all of the possible flow rates and feed stock compositions that the evaporator may be required to handle. In addition, no reliable means has been found to indicate the presence or absence of product flow through the discharge nozzle. The lack of a positive means of moving the product concentrate out of the evaporator and into a high temperature receiver is an undesirable feature of the evaporator. Pulverized glass former, or frit, was added to the evaporator feedstock in a ratio of frit to metal oxides of 2 to 1, and the resulting mixture successfully evaporated to a concentrate containing about 50 percent solids. In general, the performance of the wiped film evaporator evaluated was favorable for its use in a nuclear waste fixation process, however further development of the rotor design, power input, and operating techniques will be required to produce a free flowing solid product. (auth)

5074 (CONF-741026-) PROCEEDINGS OF THE SEMINAR ON THE MANAGEMENT OF PLUTONIUM-CONTAMINATED SOLID WASTES, MARCOULE, FRANCE, OCTOBER 14–16, 1974. (Nuclear Energy Agency, 75–Paris (France)). 1974. 250p. (In French and English). Nuclear Energy Agency, Paris.

Seventeen items have been indexed separately; seven items have been announced in both Nuclear Science Abstracts and ERDA Research Abstracts and ten additional items have been announced in Nuclear Science Abstracts. (LK)

For abstracts of individual papers see: 5075–5089, 6070, and 6075.

5075 (CONF-741026-, pp 41051) EXPERIENCES IN THE MANAGEMENT OF PLUTONIUM-CONTAINING SOLID WASTES AT THE NUCLEAR RESEARCH CENTER KARLSRUHE. Baehr, W.; Hild, W.; Scheffler, K. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

Solid plutonium-containing wastes from a fuel production plant, a reprocessing plant, and several research laboratories are treated at the decontamination department of the Karlsruhe Nuclear Research Center for disposal in the Asse salt mine. Conditioning of these wastes and description of the facilities as well as future aspects in α-waste management are discussed. (auth)

5076 (CONF-741026-, pp 52–61) UK EXPERIENCE IN THE MANAGEMENT OF Pu CONTAMINATED SOLID WASTE. Taylor, H. A. (British Nuclear Fuels Ltd., Risley, Eng.); Allardice, R. H.; Boyle, J. G.; O'Connor, L. P.; Smith, M. J. S. 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

A summary of UK experience in the management of Pu contaminated wastes is presented. Part I of the paper describes the present Windscale programme for identification of waste and its sources of arising, with preliminary criteria for methods of reducing waste arisings. Descriptions are given of Pu measurement techniques, waste storage procedures, incineration, and ash extraction. Part II discusses subsequent work anticipated for Pu measurement, processing plant design, and alternative Pu recovery systems in relation to Pu recycling in later decades. (auth)

5077 (CONF-741026-, pp 62–79) OVERVIEW OF MANAGEMENT PROGRAMS FOR PLUTONIUM-CONTAMINATED SOLID WASTE IN THE USA. Ramsey, R. W. Jr. (Atomic Energy Commission, Washington, DC); Daly, G. H.; Blasewitz, A. G.; Cooley, C. R.; Richardson, G. L. 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

Programs for transuranium-contaminated solid wastes (TRU) in the U.S.A. are emphasizing a reduction in waste generation and the development of appropriate treatments to reduce the volume of wastes requiring interim storage and final disposal. Research and Development is emphasizing the establishment of sufficient information on treatment, hazards and storage to adopt a standardized procedure for handling wastes during an interim retrievable period and for final disposal. Federal responsibility for TRU waste is being proposed except for minimum amounts acceptable for commercial burial. (auth)

5078 (CONF-741026-, pp 80–95) MANAGEMENT OF PLUTONIUM-CONTAMINATED SOLID WASTES AT THE CADARACHE CENTRE. Mery, J.; Marcaillou, J. (CEN, Cadarache, France). 1974. (In French).

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The procedure now followed with respect to each type of waste collected from the fabrication plant for plutonium-based fuels is described. This procedure includes the following operations: reduction of the volume of wastes at the production stage and estimation of the amounts of plutonium present in the wastes; reduction of the volumes of wastes to be stored, by compacting, and improvement of the characteristics of the bitumen mix; and optimization of the incineration process and necessary modifications to the incinerator so that it can deal with plutonium-contaminated wastes. (auth)

5079 (CONF-741026-, pp 96–106) MANAGEMENT OF PLUTONIUM-CONTAMINATED SOLID WASTES AT THE OARAI SITE. Sakata, S.; Kajiyoshi, M.; Matsumoto, A.; Oshima, I. (Japan Atomic Energy Research Inst., Oarai, Japan). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The paper describes the management of plutonium-contaminated wastes at the Oarai site. The two organizations cooperate in their management, the aim being to minimize production of such wastes. Treatment is at present based on the following methods: (a) incineration of low-activity combustible wastes; (b) compaction of low-activity non-combustible wastes; (c) interim storage of highly active wastes after they are enclosed in steel cans. Treatment and conditioning are performed in two types of enclosure: sealed area and half-body suit box. (auth)

5080 (CONF-741026-, pp 107-110) MANAGEMENT OF PLUTONIUM CONTAMINATED WASTES AT ROCKY FLATS. Owen, J. B. (Dow Chemical U.S.A., Golden, CO). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The U. S. Atomic Energy Commission's (USAEC) Rocky Flats Plant handles hundreds of kilograms of plutonium each year. Significant quantities of waste materials and equipment contaminated with plutonium are generated. Management systems and techniques have been developed and are in use which reduce both the volume of waste generated and the quantity of plutonium involved. Containers have been developed and are in use which meet the 20-year retrievability requirement of USAEC Immediate Action Directive (IAD) 0511-21. (auth)

5081 (CONF-741026-, pp 124-132) LONG RANGE MANAGEMENT OF TRANSURANIUM-CONTAMINATED SOLID WASTES AT SAVANNAH RIVER. Albenesius, E. L.; Reinig, W. C. (E. I. du Pont de Nemours and Co., Aiken, SC). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The Savannah River Plant, an 80,000-hectare USAEC production site in the southeastern United States, has generated solid wastes contaminated with 60,000 Ci of transuranium nuclides, chiefly ^{239}Pu, ^{238}Pu, and ^{244}Cm. These wastes, along with 300,000 Ci of transuranium wastes from other AEC sites, are stored in an 80-hectare area on the plantsite. A comprehensive planning program to retrieve and convert the wastes to noncombustible and nondispersive forms in preparation for centuries-long storage in an engineered repository is discussed. (auth)

5082 (CONF-741026-, pp 135-144) DETERMINATION OF PLUTONIUM IN SOLID WASTE CONTAINERS BY SPONTANEOUS FISSION NEUTRON MEASUREMENTS. Birkhoff, G. (EURATOM, Ispra, Italy). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The method of the determination of the plutonium content in solid waste containers by spontaneous fission neutron measurements is described. Capabilities and limitations of this method are outlined. Typical results from actual measurements on waste drums from the EUROCHEMIC reprocessing plant are reported. Measures concerning the waste management are suggested which aim to the facilitation and improvement of solid plutonium waste measurements. (auth)

5083 (CONF-741026-, pp 145-154) DETERMINATION OF PLUTONIUM CONTENT IN SOLID WASTE DRUMS: EXPERIENCE OF THE PLUTONIUM FUEL FABRICATION FACILITY. Arnal, T.; Ganivet, M. (CEN, Cadarache, France). 1974. (In French).

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The problem of increasing production of solid wastes which need to be stored or reprocessed is presented; the compositions of Pu isotopes and matrix in 100-liter drums are generally not well known. The results of a measurement system by gamma spectroscopy (NaI crystal) are compared with those obtained by chemical analysis after lixiviation of the same wastes. A new facility is described which combines a Ge-Li gamma spectrometer and a neutron detector assembly. A large improvement in accuracy and sensitivity for low fissile material contents is expected. (auth)

5084 (CONF-741026-, pp 155-162) DESCRIPTION OF THE PROCESS, TECHNOLOGY, AND BEHAVIOR IN ROUTINE OPERATION OF THE MARCOULE ALPHA INCINERATOR. Auchapt, J. M. (CEA, Marcoule, France). 1974. (In French).

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The incinerator is made to burn rubber, PVC, and cellulose wastes containing plutonium. Two years of operation at full capacity (1 kg/hr in pilot plant scale) made possible a representative critique and a reliable judgement on the technology of the process. The behavior of the installation and test results at various points of the installation are reported and conclusions are drawn for the construction of a model of larger capacity (10 kg/hr). In the larger installation the continuous feed of shredded wastes, the treatment of the dry gases, and the construction materials will be retained, but gas will be cooled only by atmospheric air dilution (without water-cooled exchanger as now) after an additional high temperature (800°C) filtration, and will be released at higher temperature than now to avoid deposits of volatile chlorides. (auth)

5085 (CONF-741026-, pp 163-171) OPERATION OF THE MARCOULE ALPHA INCINERATOR FOR HIGHLY CONTAMINATED ALPHA WASTES. Soulier, H. (CEA, Marcoule, France). 1974. (In French).

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The main operating conditions are described. Precisions are given concerning the incinerated waste composition and the main difficulties encountered. The recovery of fissile materials from their ashes is possible; a procedure is briefly described. The results of two years of operation with active feed allow us to assess the technical and economical advantages of this type of process, in reducing the volume of wastes and in recovering eventually fissile material, with a unit of adequate throughput. (auth)

5086 (CONF-741026-, pp 172-185) ACID DIGESTION PROCESS FOR TREATMENT OF COMBUSTIBLE WASTES. Cooley, C. R.; Lerch, R. E. (Westinghouse Hanford Co., Richland, WA). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

Acid digestion is a process being developed at the Hanford Engineering Development Laboratory (HEDL) in Richland, Washington, to reduce the volume of alpha-contaminated combustible waste by converting it into a non-combustible residue. Typical waste materials such as polyvinylchloride (PVC), polyethylene, paper and other cellulose materials, ion exchange resin, all types of rubber, etc., are digested in hot (230 to 270°C) concentrated sulfuric acid containing nitric acid oxidant to form inert residues having less than 4 percent of their original volume. The process is currently being tested in a non-radioactive Acid Digestion Test Unit (ADTU) using all glass equipment. Engineering tests to date have shown acid digestion to be a potentially attractive method for treating combustible waste materials. (auth)

5087 (CONF-741026-, pp 186-192) VOLUME AND ACTIVITY REDUCTION OF ALPHA CONTAMINATED SOLID WASTES BY CRYOGENIC CRUSHING AND LEACHING. Ganivet, M.; Cousinou, G. (CEN, Cadarache, France). 1974. (In French).

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

A new method for the treatment of Pu-contaminated solide wastes is proposed. This method is based in a first step on a cryogenic crushing at −70°C; in a second step, the crushed wastes are leached successively by citric acid for removing ionic forms of plutonium and by a detergent for removing the powder of plutonium oxide. After this treatment, wastes are dryed, compacted, checked for residual plutonium content and stored. The volume reduction is near a factor of ten. The detergent solution is recycled after powder separation; the plutonium removed from wastes by citric acid and detergent solution can be recycled in fabrication plant. (auth)

5088 (CONF-741026-, pp 193-206) PLUTONIUM CONTAMINATED SOLID WASTE PROGRAMS. Johnson, L. J.; Jordan, H. S. (Los Alamos Scientific Lab., NM). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

Development of handling and storage criteria for plutonium contaminated solid waste materials is discussed. Data from corrosion and radiolytic attack studies are reviewed. Instrumentation systems developed for solid waste management applications at the 10 nCi Pu/g waste material level is described, and their sensitivity and operational limitations reviewed. Current programs for the environmental risk analysis of past waste disposal areas and for development of technology for the volume reduction and chemical stabilization of transuranic contaminated solid waste are outlined. (auth)

5089 (CONF-741026-, pp 207-222) CONCEPTUAL SYSTEM FOR HANDLING ALPHA-BEARING WASTES. Jansen, G.; Schneider, K. J.; Hammond, V. L. (Battelle Pacific Northwest Labs., Richland, WA). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

This paper presents the design of a hypothetical system for identifying, transporting, processing, and storing non-high-level radioactive wastes exclusive of mine tailings. Waste identification is based on state and federal regulations and toxicity indexes as a function of decay time. Because of a multiplicity of small sources of liquid and solid wastes, the waste repository is equipped with a processing facility for receiving, sorting, solid volume reduction, liquid volume reduction and solidification, and packaging wastes at a rate equal to the generation rate in 1980. Storage of canned waste is partly in shielded and partly in unshielded high-integrity warehouses for an interim period of 100 years. Costs for this hypothetical system in 1973 dollars are estimated to be $30 million for transportation, $20 million for the processing facility, $24 million for the storage facility, and $7 million in annual operating costs. (auth)

5090 (CONF-750542-6) POST TREATMENT OF HIGH-LEVEL NUCLEAR FUEL WASTES. Berreth, J. R.; Cole, H. S.; Hoskins, A. P.; Lewis, L. C.; Samsel, E. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). 1975. Contract AT(10-1)-1375. 25p. Dep. NTIS $4.50.

From 77th annual meeting of the American Ceramic Society; Washington, District of Columbia, USA (3 May 1975).

The glass-ceramic product prepared from fluidized-bed calcined synthetic commercial wastes, based on data obtained to date, has many of the properties desired for long-term storage. Although more characterization is necessitated, the product's high-calcine content will decrease the number of storage canisters required and use a minimum of product-forming additives, resulting in significant process cost savings. The product remains in a solid, nonflowing form at temperatures close to the preparation temperature and yet is prepared at relatively low temperatures. The product has void spaces to accommodate radiolytic gas formation, but is hard and dense and has very low leach rates. Process features, such as no direct product contact with furnace or storage canisters, will minimize corrosion of both process equipment and storage canisters. (auth)

5091 (CONF-751104-4) SOME ACTIVITIES IN THE UNITED STATES CONCERNING THE PHYSICS ASPECTS OF ACTINIDE WASTE RECYCLING. Raman, S. (Oak Ridge National Lab., Tenn. (USA)). 1975. 15p. Dep. NTIS $4.00.

From IAEA advisory group meeting on transactinium isotope nuclear data; Karlsruhe, F. R. Germany (3 Nov 1975).

Reactor types being considered in the United States for the purpose of actinide waste recycling are discussed briefly. The reactor types include thermal reactors operating on the 3.3 percent ^{233}U–^{238}U and the ^{233}U–^{232}Th fuel cycles, liquid metal fast breeder reactors, reactors fueled entirely by actinide wastes, gaseous fuel reactors, and fusion reactors. Cross section measurements in progress or planned toward providing basic data for testing the recycle concept are also discussed. (auth)

5092 (CONF-751107--4) FLUIDIZED-BED CALCINATION OF SIMULATED COMMERCIAL HIGH-LEVEL RADIOACTIVE WASTES. Freeby, W. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Nov 1975. Contract AT(10-1)-1375. 17p. Dep. NTIS $4.50.

From 68th annual meeting of American Institute of Chemical Engineering; Los Angeles, California, USA (16 Nov 1975).

Work is in progress at the Idaho Chemical Processing Plant to verify process flowsheets for converting simulated commercial high-level liquid wastes to granular solids using the fluidized-bed calcination process. Primary emphasis in the series of runs reported was to define flowsheets for calcining simulated Allied-General Nuclear Services (AGNS) waste and to evaluate product properties significant to calcination, solids storage, or post treatment. Pilot-plant studies using simulated high-level acid wastes representative of those to be produced by Nuclear Fuel Services, Inc. (NFS) are also included. Combined AGNS high-level and intermediate-level waste (0.26 M Na in blend) was successfully calcined when powdered iron was added (to result in a Na/Fe mole ratio of 1.0) to the feed to prevent particle agglomeration due to sodium nitrate. Long-term runs (approximately 100 hours) showed that calcination of the combined waste is practical. Concentrated AGNS waste containing sodium at concentrations less than 0.2 M were calcined successfully; concentrated waste containing 1.13 M Na calcined successfully when powdered iron was added to the feed to suppress sodium nitrate formation. Calcination of dilute AGNS waste by conventional fluid-bed techniques was unsuccessful due to the inability to control bed particle size–both particle size and bed level decreased. Fluid-bed solidification of AGNS dilute waste at conditions in which most of the calcined solids left the calciner vessel with the off-gas was successful. In such a concept, the steady-state composition of the bed material would be approximately 22 wt percent calcined solids deposited on inert particles. Calcination of simulated NFS acid waste indicated that solidification by the fluid-bed process is feasible. (auth)

5093 (LA-6100-PR) TRANSURANIC SOLID WASTE MANAGEMENT PROGRAMS. Progress Report, July--December 1974. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 60p. Dep. NTIS $5.45.

Progress is reported for three transuranic solid waste management programs funded at the Los Alamos Scientific Laboratory by the Energy Research and Development Administration Division of Waste Management and Transportation. Under the Transuranic Waste Research and Development Program, a completed evaluation of stainless steel drums showed that although the material has superior corrosion-resistant properties, its higher cost makes a thorough investigation of other container systems mandatory. A program to investigate more economical, nonmetallic containers is proposed. Preliminary fire tests in mild steel drums have been completed with fire propagation not appearing to be a problem unless container integrity is lost. Investigation of the corrosion of mild steel drums and the evaluation of potential corrosion inhibitors in a variety of humid environments continues. Experimental results of both laboratory and field investigations on radiolysis of transuranic elements in hydrogenous waste are discussed. Progress in the development of instrumentation for monitoring and segregating low-level wastes is described. New plans and developments for the Transuranic-Contaminated Solid Waste Treatment Development Facility are presented. The current focus is on a comparison of all alternative waste reduction systems toward a relative Figure of Merit with universal application. Drawings, flowsheets, and building layouts are included, and the proposed incinerator device is detailed. The release mechanisms, inter- and intraregional transport mechanisms, and exhumation studies relevant to the Evaluation of Transuranic-Contaminated Radioactive Waste Disposal Areas Program are defined and analyzed. A detailed description is given of the formulation of the computer simulation scheme for the intraregional biological transport model. (auth)

5094 (UCRL-51910) PERFORMANCE OF A URANIUM GETTER BED FOR REMOVING DEUTERIUM FROM A FLOWING INERT GAS. Folkers, C. L.; Maienschein, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1975. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.00.

The performance of a uranium trap as a means of removing tritium from an inert gas was measured for varying trap conditions, using deuterium (to represent tritium) in argon at room temperature. Performance was expressed as a purification factor, which is the ratio of deuterium concentration at the inlet to that at the outlet of the trap. Purification factors vary inversely with both the ratio of deuterium to uranium already contained in the trap and with the rate of flow of gas through the trap. Varying the inlet deuterium concentration had no apparent effect. (auth)

5095 COMPARATIVE STUDY OF ABILITY OF SOME ION EXCHANGERS TO DECONTAMINATE RADIOACTIVELY POLLUTED WATERS AND THEIR REGENERATIVE CAPACITY. Pantev, T.; Mikhaylov, M. G.; Vasilev, G. (Scientific Research Inst. of Radiobiology and Radiation Hygiene, Sofia). Rentgenol. Radiol.; 14: No. 2, 113-118(1975). (In Bulgarian)

The purpose of the study was to determine the operating efficiency and conditions for a decontaminating system consisting of carboferrogel and sulfonated coal or series-connected ion-exchange resins, viz. the wolfatite KPS (H) and SBW (OH), as well as to establish and compare the retentive efficiency of the wolfatites SBW and SBK with respect to strontium-85, cesium-137 and iodine-131, alone or in an isotopic mixture, and investigate the regenerative efficiency and capacity of sulfonated coal and

KPS (H) and SBW (OH) after saturation. It was found that the decontaminating system carboferrogel + KPS (H) + SBW (OH) is highly effective for the decontamination of waters polluted with radioactive cesium, strontium and iodine or a mixture thereof. The wolfatites KPS and SBW can be regenerated with a comparatively low consumption of the regenerating reagent, which almost completely restores their initial retentive efficiency. (JPRS)

5096 IONIC FLOTATION OF RADIOACTIVE MICROCOMPONENTS. Pustovalov, N. N.; Pushkarev, V. V. Sov. Radiochem.; 16: No. 2, 242-244(1974).

Translated from Radiokhimiya; 16: No. 2, 240-242(1974).

It was shown that the extraction of microamounts of isotopes from aqueous solutions by the ionic flotation method by means of ionogenic surface-active substances occurs as a result of the penetration of the isotopes into the electrical double layer which arises at the solution–air interphase. (auth)

5097 EFFECT OF ADDED ELECTROLYTES ON IONIC FLOTATION OF RADIOACTIVE MICROCOMPONENTS. Pustovalov, N. N.; Pushkarev, V. V. Sov. Radiochem.; 16: No. 2, 245-248(1974).

Translated from Radiokhimiya; 16: No. 2, 243-247(1974).

On the basis of the electrochemical sorption model of the extraction of radioisotopes we obtained an equation which describes the effect of added electrolytes on the extraction of isotopes from aqueous solutions by the ionic flotation method and agrees satisfactorily with experimental data. (auth)

5098 MANAGEMENT OF COMMERCIAL RADIOACTIVE WASTE IN THE UNITED STATES. Pittman, F. K. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 33(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Radioisotope Production

Refer also to abstracts 5002 and 6090.

5099 (CNAEM-R-148) PRODUCTION OF RADIOISOTOPE ^{28}Mg BY (n,α)–(t,p) REACTION AT NUCLEAR REACTOR. Gulbaba, G. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1975. 8p. Dep. NTIS (US Sales Only) $4.50. Preparation of Li–Mg alloy targets, irradiation, chemical isolation and purification of ^{28}Mg from target, and measurement of activities are covered. (LK)

5100 FAST GAS-THERMOCHROMATOGRAPHIC SEPARATION OF RADIOACTIVE ELEMENTS. III. Production and Thermochromatographic Behavior of Volatile Oxides and Hydroxides of Radioactive Tungsten. Bayar, B.; Novgorodov, A. F.; Vocilka, I.; Zaitseva, N. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochem. Radioanal. Lett.; 22 No. 1, 53-62(30 Jun 1975).

High temperature (≥1000°C) sublimation and thermochromatographic behavior of ultramicro and micro amounts of radioactive tungsten in oxygen stream were investigated. Dependences on the partial pressure of water vapor in the carrier gas, on the rate of the carrier gas and on sublimation time were looked at. On the basis of the data obtained the fast gas-thermochromatographic method of separating radiochemically pure, carrier-free tungsten from Ta and Au targets irradiated with high-energy protons has been developed. (auth)

5101 SORPTION OF SOME RADIOELEMENTS BY THE INORGANIC SORBENT TIN(IV) PHOSPHATE. III. Sorption of Niobium(V) from Nitric Acid Solutions. Krylov, V. N.; Pitalev, V. G.; Pospelov, A. A. Sov. Radiochem.; 16: No. 2, 149-152 (1974).

Translated from Radiokhimiya; 16: No. 2, 148-152(1974).

A study was made of the relation of the sorption of niobium(V) by tin phosphate from nitric acid solutions to the synthesis conditions of the sorbent and the nitric acid concentration. It was shown that the sorption of niobium(V) increases as a rule with an increase in the specific surface of the sorbent. However, since the niobium(V) is probably in the form of coarse polymeric particles under the experimental conditions, the sorption process is also determined by the pore size of the sorbent. A study was made of the kinetics of sorption of niobium(V) by tin phosphate from 2 M HNO_3 solution over the temperature range of 20-80°C. It was shown that radiochemically pure ^{95}Nb may be obtained by filtering a solution containing a mixture of ^{95}Zr and ^{95}Nb through a tin phosphate column. (auth)

5102 SEPARATION OF MULTICOMPONENT SYSTEMS BASED ON RARE-EARTH ELEMENTS BY THE ELECTROFOCUSSING METHOD. Shvedov, V. P.; Ivanov, V. I. Sov. Radiochem.; 16: No. 2, 230-232(1974).

Translated from Radiokhimiya; 16: No. 2, 229-231(1974).

New methods are proposed for calculating the focussing pH and in this way it is possible to select conditions for separating rare-earth elements by the electrofocussing method. An investigation was made of the separation of the systems ^{90}Y–^{90}Sr–^{144}Ce–^{147}Pm–^{155}Eu, ^{90}Y–^{90}Sr–^{144}Ce–^{143}Pr–^{147}Pm–^{155}Eu, and ^{144}Ce–^{147}Nd–^{147}Pm–^{153}Sm–^{155}Eu by means of NTA, EDTA, and DTPA. It was established that the best separation conditions may be obtained with EDTA and DPTA. The use of NTA is less effective because of incomplete separation. (auth)

5103 RADIOCHEMICAL SEPARATION OF INDIUM AND TIN. Gureev, E. S.; Usachenko, V. S.; Brodskaya, G. A. Sov. Radiochem.; 16: No. 2, 291-293(1974).

Translated from Radiokhimiya; 16: No. 2, 286-288(1974).

An investigation was made of the extraction and reextraction of indium and tin in the system di-2-ethylhexylorthophosphoric acid–mineral acids, using as the latter nitric, hydrochloric, and perchloric acids and a mixture of the last two. An extraction-chromatography method was developed for separating indium and tin and a carrier-free indium-113m was obtained. (auth)

5104 STUDIES ON THE PREPARATION OF ^{113}Sn–^{113m}In GENERATORS. Ramamoorthy, N.; Narasinhan, D. V. S.; Mani, R. S. (Bhabha Atomic Research Centre, Bombay). Isotopenpraxis; 11: No. 7, 246-252(Jul 1975).

Presently available ^{113}Sn–^{113m}In generators use high specific activity ^{113}Sn which cannot be produced in low and medium flux research reactors even with enriched ^{112}Sn. A method is described for preparing ^{113}Sn–^{113m}In generators using ^{113}Sn of relatively low specific activity (2 to 3 Ci/g) obtained by irradiation of enriched ^{112}Sn in CIRUS. In this modified procedure, $^{113}SnCl_4$ is firmly adsorbed on hydrous zirconia from 3 to 4 M NaCl solutions of pH 1.3 to 1.5 and the elution of ^{113m}In is effected by dilute HCl. The generator yields 70% of the theoretically available ^{113m}In activity. ^{113}Sn breakthrough was consistently less than 0.01% of the ^{113m}In activity. Stable zirconium contamination in the eluate was estimated to be less than 1 ppM. The performance characteristics of different varieties of hydrous zirconia were studied to evaluate the optimum tin loading, indium elution, and soluble zirconium contamination. Generators containing up to 100 mCi of tin-113 were prepared yielding pure indium-113m suitable for medical use. (auth)

5105 HISTORICAL SKETCH OF THE DISCOVERY, PRODUCTION, AND APPLICATION OF RADIOISOTOPES. Williams, C. (Brookhaven National Lab., Upton, NY). Nucl. Technol.; 27: No. 1, 119-123(Sep 1975).

The Joliot-Curies made the first artificial radioisotope (^{30}P) by bombarding aluminum with alpha particles. The development of the cyclotron and other high-energy particle accelerators in the early 1930's led to the production of numerous radioisotopes in measurable quantities. By the beginning of the 1950's, with the abundant neutron fluxes available at the U. S. Atomic Commission reactors, radioisotopes of many species really became abundant. Naturally occurring radioactive lead had been used very sparingly as tracers as far back as 1918 in determining chemical solubility and in 1923 in plant uptake from lead solutions. Now many new uses were developed and tested as tracers in medical diagnosis, agricultural, and industrial chemical and metallurigical processes. Many therapeutic applications were tested. The industrial labs developed thickness and level gauges for control of various manufacturing processes. Cobalt gamma-ray irradiators were developed for medical therapy and have also been used for sterilization of surgical instruments and materials, for food preservation, and for initiation of certain chemical reactions. The most significant development in the 1960's was the rapidly increasing role of private industry in taking over the development, production, sales, as well as research, into new methods of production and applications of radioisotopes. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 4971, 5570, and 6665.

5106 (CONF-751115--3) MULTIPURPOSE REPROCESSING HOT CELL. Fletcher, R. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 16 Nov 1975. 3p. Dep. NTIS $4.50.

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975).

A multipurpose hot cell for use in the new head end system is described. The use of a hot cell as part of the routine fuel charging procedure provides considerable flexibility in handling a wide variety of fuel sizes up to 25,000 lb. (LK)

5107 (DOCKET-50201-170) WEST VALLEY REPROCESSING PLANT. IE Inspection Report No. 75-06. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 19 Aug 1975. 14p. Dep. NTIS $4.00.

The findings of a routine, unannounced inspection are summarized. (LK)

5108 NONDESTRUCTIVE ASSAY TECHNIQUES FOR RECYCLES ^{233}U FUEL FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Rushton, J. E.; Jenkins, J. D.; McNeany, S. R. (Oak Ridge National Lab.; TN). Nucl. Mater. Manage.; 4: No. 1, 18-35(Apr 1975).

Nondestructive fissile material assay techniques are reviewed for application to the refabrication of recycled ^{233}U fuel for High Temperature Gas-Cooled Reactors (HTGR). The refabrication processes and fuel characteristics are identified and explained, and nondestructive assay techniques are evaluated in light of these characteristics and assay requirements. It is concluded that currently developed and implemented gamma-ray assay techniques for ^{235}U and ^{239}Pu are not applicable to ^{233}U fuel because of its high radioactivity. Calorimetry has potential for ^{233}U fuel assay if appropriate corrections for isotopic composition can be applied. For most nondestructive assay requirements, active interrogation methods must be employed. Neutron interrogation systems using either ^{252}Cf or ^{124}Sb-Be neutron sources and delayed or prompt fission neutron detection offer the greatest potential for assay of HTGR recycle ^{233}U fuel. The presence of hydrogen in some of the fuel forms during processing and the particulate nature of the HTGR fuel complicate the direct application of these neutron interrogation techniques. Photofission techniques, which offer enhanced penetrability for the assay of bulk fuel quantities or fuel elements, cannot be evaluated for this application because of a lack of basic data. (auth)

5109 CLOSING THE NUCLEAR FUEL CYCLE. Carson, A. B.; Lambert, R. W.; Wolfe, B. (General Electric Co., San Jose, CA). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 32-33(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5110 CONCEPTUAL STUDY FOR A FUEL REPROCESSING PILOT PLANT IN MEXICO. Kaufmann, F.; Gutierrez, F. P.; Dominguez, J. J.; Suarez, M. A. G.; Rosales, G. A. S. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 32-35(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

CONTROLLED THERMONUCLEAR RESEARCH

5111 (TID-3557-S10) CONTROLLED FUSION AND PLASMA RESEARCH, A Literature Search. Whitson, M. O. (comp.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Oct 1975. 512p. Dep. NTIS $13.60.

This bibliography contains 4584 references to journal and report literature that cover information on various aspects of controlled fusion research. Corporate author, personal author, report number, and subject indexes are included. (auth)

Plasma Confinement and Heating

Refer also to abstract 5311.

5112 (COO-2218-38) MONTE CARLO SIMULATION OF NEUTRAL BEAM INJECTION INTO FUSION REACTORS. Miller, P. L. (Illinois Univ., Urbana (USA)). 15 Sep 1975. Contract AT(11-1)-2218. 31p. Dep. NTIS $5.00.

Motivations and techniques for the Monte Carlo computer simulation of energetic neutral beam injection for fusion reactors are described. The versatility of this approach allows a significantly more sophisticated treatment of charge transfer collision phenomena and consequent effects on engineering design than available from prior work. Exemplary results for a mirror Fusion Engineering Research Facility (FERF) are discussed. (auth)

5113 (ERDA-tr--69) INVESTIGATION OF THE INTERACTION OF HIGH-FREQUENCY OSCILLATIONS IN THE DECIMETER RANGE WITH PLASMA IN THE TOKAMAK TM-3 UNIT. Alikaev, V. V.; Arsen'ev, Yu. I.; Bobrovskii, G. A.; Poznyak, V. I.; Razumova, K. A.; Sokolov, Yu. A. Translated from Zh. Tekh. Fiz.; 45: No. 3, 523-526(1975). 8p. Dep. NTIS $4.00.

The phenomena arising during the interaction of high-frequency radiation with plasma, primarily under the conditions omega/sub He/ greater than omega greater than or equal to root omega/sub He/omega/sub Hi/ and omega/sub pe/ greater than omega greater than or equal to omega/sub pi/ was studied. Considerable absorption of the high-frequency power was observed throughout the entire range of parameters characterizing the Tokamak plasma. This absorption was accompanied by ion heating, additional displacement of the plasma column, and the appearance of hard x-ray radiation. (auth)

5114 (EUR-CEA-FC-767) HOT ELECTRON TARGET PLASMAS. I Circe Experiment. Bardet, R.; Briand, P.; Dupas, L.; Gormezano, C.; Melin, G.; Werkoff, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). Apr 1975. 59p (In French). Dep. NTIS (US Sales Only) $5.50.

The main parameters of the CIRCE experiment are described. The plasma is obtained by the trapping of a plasma injected in a magnetic bottle by electron heating at cyclotron resonance. The plasma density lies between 5×10^{11}cm^{-3} and 10^{12}cm^{-3}, the electron temperature is about 100 keV and the ion temperature in the range of few hundred eV. Gross instabilities are not observed. The ratio of the plasma density to the neutral gas density inside the plasma is higher than 100. Few kilowatts of rf power at 8 GHz are sufficient to get these results which looks to be encouraging for the creation of a more performing fast neutral plasma target using the CIRCE experiment concept. (auth)

5115 (EUR-CEA-FC-770) PARAMETRICALLY UNSTABLE ION SOUND WAVES. Canobbio, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). May 1975. 25p. Dep. NTIS (US Sales Only) $4.50.

The dispersion relation is derived for parametric instabilities caused by an intense ion sound wave which couples high and low frequency electrostatic modes of a nonisothermal unmagnetized homogeneous plasma. The phase velocity of the pump wave is between the ion and the electron thermal speed. The dispersion relation contains filamentational, modulational, and stimulated scattering instabilities. Growth rates as a function of the pump and plasma characteristics are given. For a given amplitude of the pump, $|\phi_0|$, the largest growth rate is found in the case of filamentation instability, which becomes explosive in nature when: $|e\phi_0|^2/T_iT_e \simeq (k\lambda_D)^2$, where λ_D is the Debye length. The particular physical situation studied is related only loosely to any actual rf heating experiment. However, it allows to clarify some new basic parametric processes occurring during rf heating below and around the ion gyrofrequency. Finally, the relevance of this and other more general parametric instabilities from the point of view of plasma heating and confinement, is briefly discussed. (auth)

5116 (LA-UR--75-2030) PLASMA HEATING BY RELATIVISTIC ELECTRON BEAMS: CORRELATIONS BETWEEN EXPERIMENT AND THEORY. Thode, L. E.; Godfrey, B. B. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 35p. (CONF-751108--6). Dep. NTIS $4.50.

From first international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

The streaming instability is the primary heating mechanism in most, if not all, experiments in which the beam is injected into partially or fully ionized gas. In plasma heating experiments, the relativistic beam must traverse an anode foil before interacting with the plasma. The linear theory for such a scattered beam is discussed, including a criterion for the onset of the kinetic interaction. A nonlinear model of the two-stream instability for a scattered beam is developed. Using this model, data from ten experiments are unfolded to obtain the following correlations: (i) for a fixed anode foil, the dependence of the plasma heating on the beam-to-plasma density ratio is due to anode foil scattering, (ii) for a fixed beam-to-plasma density ratio, the predicted change in the magnitude of plasma heating as a function of the anode foil is in agreement with experiment, and (iii) the plasma heating tentatively appears to be proportional to the beam kinetic energy density and beam pulse length. For a fixed anode foil theory also predicts that the energy deposition is improved by increasing the beam electron energy gamma mc^2. Presently, no experiment has been performed to confirm this aspect of the theory. (auth)

5117 (LBL--3262) PLASMA CONTAINMENT IN A TOROIDAL BICUSP (TORMAC). Levine, M. A.; Brown, I. G.; Gallagher, C. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-ENG-48. 5p. (CONF-750971--1). Dep. NTIS $4.00.

From third international conference on alpha beta plasma; Culham, UK (9 Sep 1975).

The stable confinement of a fully ionized, high-beta plasma in a toroidal bicusp (Tormac) is discussed. The bicusp geometry is described along with "shaker" heating by magnetoacoustic waves propagating orthogonal to the internal toroidal magnetic field. (MOW)

5118 (ORNL-TM--4843) DYNAMIC OVERALL ENERGY BALANCE OF CLEAN AND IMPURITY-CONTAMINATED TOKAMAK REACTORS. Hiraoka, T.; McNally, J. R. Jr.; Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 124p. Dep. NTIS $5.45.

The energy balance of fusion reactors was investigated from the viewpoints of both physics and engineering requirements, but most of the previous investigations have been static analyses. On the other hand, dynamic behavior was studied for clean plasma. The energy balance for impurity-contaminated reactors should be investigated dynamically because impurities shorten the burning time considerably. Moreover, it is necessary to evaluate the energy balance of the whole reactor system, including engineering aspects that support plasma burning over a complete cycle. The reactor system to be analyzed should be self-consistent with regard to plasma-physics and reactor-engineering parameters, and realistic engineering limitations must be imposed. A zero-dimensional model is assumed, and the dynamic overall energy balance is investigated over a complete cycle (from the initial heating stage until the beginning of the next discharge). Simultaneous time-dependent differential equations are solved for particle density and ion and electron temperatures based on trapped particle mode losses. (auth)

5119 (UCID-16914) COMPACT HIGH-ENERGY NEUTRAL BEAM SYSTEM. Anderson, O. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.50.

Pumping requirements for handling excess gas in a CTR high-energy neutral beam system are substantially reduced by using a cesium jet to act simultaneously as the charge-changing mechanism and as a reflector for excess deuterium gas. Practical applications and problems such as cesium contamination of the D^+ source are discussed. (auth)

5120 (UCRL-77152) SELF-CONSISTENT MICROWAVE PLASMA HEATING RATES. Ensley, D. L.; White, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1975. 31p. (CONF-751108-11). Dep. NTIS $4.50.

From 1st international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Under conditions within a hot overdense plasma corona where the field frequency is much less than the electron plasma frequency and the field period is much less than the hydrodynamic expansion time it is shown that electron field reversal heating can exceed the combined classical heating rates due to inverse bremsstrahlung (skin effect) and field pressure (PdV) by a factor approximately v/sub e//2v/sub i/ (half the ratio of electron and ion thermal velocities). In particular this rate can exceed the inertial expansion cooling rate at a collisionless corona density of approximately 1 percent solid core density and could be realized experimentally at core temperatures approximately 3–5 keV and microwave field intensities approximately 1 MG. (auth)

5121 (UCRL-Trans-10954) COMPRESSION OF A DENSE TOROIDAL PLASMA WITH BETA GREATER THAN 1 BY A GAS PISTON. Kurtmullaev, R. Kh.; Lunin, A. L.; Semenov, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Nov 1975. Translation of a Russian Report. 17p. Dep. NTIS $4.50.

A method is considered for creating a toroidal plasma in a system with nonmagnetic confinement. The process of gas breakdown, formation of the toroidal structure, and heating of the plasma takes place in two stages. Initially, a gas pressure is created in the chamber in the range corresponding to the usual conditions for a gas discharge (n_0 approximately 10^{15} cm^{-3}). The gas breaks down, a closed magnetic structure forms, and initial heating to a temperature of 1 to 2 keV takes place. Some calculations are described. (MOW)

5122 JFT-2 TOKAMAK EXPERIMENT. Fujisawa, N.; Funahashi, A.; Kunieda, S. (Japan Atomic Energy Research Inst., Tokai). pp 3-16 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Recent experimental results are reported on the plasma confinement and the dynamic limiter experiments in the JFT-2 tokamak. Radial profiles of electron temperatures in hydrogen plasma were measured by the Thomson scattering method. The electron temperatures reach peak values of 250–450 eV at the center. The electron densities and temperatures start to decrease before the peak of a plasma current. Ion temperatures, measured by charge-exchanged neutral particles, reach peak values of 210 eV. Radial profiles of the ionization rate, the neutral particle density and the particle diffusion coefficient are deduced from detailed measurements of the photon flux of the Hα-line. The dynamic limiter is composed of two molybdenum plates which are set parallel to each other inside the vacuum vessel and can be derived upwards and downwards pneumatically. The average and maximum speeds of the dynamic limiter are 5 m/s and 9 m/s, respectively. The results of the measurements of the radial density profile and the radial Hα-photon flux profile show that the density near the plasma boundary diffuses together with the dynamic limiter, but that the region of the hot core of the plasma does not expand. (auth)

5123 RADIATION FROM PLASMAS IN THE ST-TOKAMAK. Bretz, N.; Dimock, D.; Greenberger, A.; Hinnov, E.; Meservey, E.; Stodiek, W.; Von Goeler, S. (Princeton Univ., NJ). pp 55-64 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Quantitative vacuum ultraviolet (UV) measurements (lambda greater than or equal to 100 A) of various ST-Tokamak discharges show that the atom density of metal impurities is about 0.1 to 1.5 percent of the electron density and that the atom density of oxygen is about 1 to 10 percent. These concentrations yield an effective ionic charge, anti Z, consistent with the measured current, voltage, and profiles of electron temperature. The radial distribution of high-Z material is obtained from x-ray measurements in the range 1 A less than or equal to lambda less than or equal to 4 A; from these one concludes that there is no extreme concentration of high-Z material in the center, but cannot exclude variations within a factor of 2. The x-ray spectrum is dominated by recombination; using bremsstrahlung and recombination calculations the value of anti Z derived from x-ray intensity is comparable with the value from conductivity. An instrument is described for making measurements in the extreme UV region (5 less than lambda less than 20 A). In this range strong emission has been obeserved (radiated power about 10 percent of power input in the center), which is attributed to line emission from heavy-metal (Fe or Mo) ions which are produced only at an electron temperature above about 1200 eV; the very narrow radial profile of observed intensity is consistent with measured temperature and density profiles. Rough estimates of the concentration of heavy metals required to account for the radiated power are consistent with vacuum UV and x-ray data. (auth)

5124 WAVE GENERATION AND HEATING IN THE ST-TOKAMAK AT THE FUNDAMENTAL AND HARMONIC ION CYCLOTRON FREQUENCIES. Adam, J.; Chance, M.; Eubank, H. (Princeton Univ., NJ). pp 65-73 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Theoretical and experimental investigations of wave generation and heating at the fundamental and the first harmonic of the ion cyclotron frequency are reported. General theoretical considerations are followed by a description of experiments on the ST-Tokamak designed to test the feasibility of this heating scheme for providing the additional heating required for toroidal reactor operation. Two rf-coils were used in an enlarged section of the ST vacuum vessel to allow operation up to approximately 1 MW of rf-power. Wave generation efficiencies of approximately 90 percent were computed from theory and observed experimentally. The ion cyclotron (slow) wave is observed to be strongly damped, but the fast hydromagnetic wave is seen to propagate many times around the machine so that standing toroidal eigenmodes are generated. The dependence of the eigenmode resonances on the density and magnetic field agrees closely with a theory based on a cylindrical, cold-plasma model. At omega equals 2 omega/sub ic/, with relatively short RF-pulses, the ion temperature approximately doubles and increases by approximately 100 eV, corresponding to a heating efficiency of approximately 20 percent. At omega equals omega/sub ic/, the ion temperature increases by only 25 percent under similar conditions. Longer RF-pulses lead to a neutral-particle influx which tends to constrict the current channel and leads to MHD-instabilities. The impurity component of this influx also leads to enhanced ion heating by decreasing the ion-electron equipartion time. The temperature increases quoted are for conditions where the effect of this neutral influx was negligible. (auth)

5125 NEUTRAL-BEAM HEATING IN THE ADIABATIC TOROIDAL COMPRESSOR. Bol, K.; Cecchi, J. L.; Daughney, C. C. (Princeton Univ., NJ). pp 77-82 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Results are given for tangential injection into ATC of two 15-keV neutral beams with net power up to 100 kW. The ion temperature rise exceeds 100 eV, consistent with theoretical expectations. Fast-ion drag rates and pitch-angle scattering have been measured, the latter to determine Z/sub eff/. Injection was also made at 83 and 97° to the plasma current. At 83° some ion heating is observed; at 97° the heating is negligible. The fast-ion energy distributions, observed tangentially, show the severity of the "loss-region" for counter-circulating particles. (auth)

5126 EXPERIMENTS ON THE ADIABATIC TOROIDAL COMPRESSOR. Bol, K.; Cecchi, J. L.; Daughney, C. C. (Princeton Univ., NJ). pp 83-97 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Magnetic compressional heating of a tokamak discharge has been demonstrated successfully in the Adiabatic Toroidal Compressor (ATC). In addition to these investigations of compressional heating, other basic measurements have been made on ATC recently. These measurements are of interest because the ATC incorporates an air-core transformer and dispenses with the usual copper shell, two features likely to be found on future larger devices with smaller aspect ratios. The following topics are discussed: (1) characteristics of the uncompressed discharges in ATC, including the dependence of beta/sub p/ on discharge parameters, bolometric measurements of the energy balance, measurements of the concentration of impurities; (2) MHD-behavior and attempts at stabilization of the m equals 2 kink-tearing mode. (auth)

5127 PLASMA CONFINEMENT IN THE ORMAK DEVICE. Berry, L. A.; Callen, J. D.; Clarke, J. F. (Oak Ridge National Lab., TN). pp 101-112 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Experiments in two different operating regimes of the Oak Ridge Tokamak (ORMAK), with Ohmic heating, are discussed. The confinement characteristics of a broad-profile discharge in a low-density regime and a peaked-profile discharge at high density are described in detail. Through charge-exchange analysis, particle diffusion coefficients for these discharges are evaluated, and it is shown that the particle diffusion is not a significant energy loss for the present operating conditions. Detailed examination of the radial power flow for the ions indicates that the dominant loss from the core is heat conduction, the form (and magnitude) of which is consistent with the neoclassical predictions, provided local collision frequencies are enhanced by an amount comparable to that inferred from the resistance anomaly. Examination of the electron power flow suggests anomalous behavior of the electrons. However, for the broad-profile discharges, average confinement parameters, such as beta/sub p/ or the energy confinement time, are reasonably consistent with pseudoclassical predictions. With increasing electron density, overall confinement improves, in spite of profile peaking (beta/sub p/ approximately anti n/sub e//I). The resistance anomaly is observed to scale roughly as I/sup alpha//anti n/sub e/, where alpha approximately 1. At high densities, the volume-averaged effective ionic charge, (Z/sub eff/)/sub res/, inferred from resistance anomaly, shows a rough agreement with (Z/sub eff/)/sub meas/, inferred from direct measurements (vacuum-ultraviolet spectroscopy, soft-X-ray, and charge-exchange analysis of pitch-angle-scattered fast ions in the neutral-beam injection). However, with decreasing densities, (Z/sub eff/)/sub res/ becomes (by a factor greater than or equal to 2) higher than (Z/sub eff/)/sub meas/, suggesting that the possibility of turbulent enhancement cannot be excluded. (auth)

5128 NEUTRAL BEAM INJECTION EXPERIMENTS IN ORMAK. Berry, L. A.; Bush, C. E.; Dunlap, J. L.; Edmonds, P. H.; Jernigan, T. C.; Lyon, J. F.; Murakami, M.; Wing, W. R. (Oak Ridge National Lab., TN). pp 113-124 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Two energetic (each approximately 26 kV, 100 kW) neutral beams were used to supplement the larger Ohmic heating of the Oak Ridge Tokamak (ORMAK) plasma. Long, constant discharge-current times and beam pulse lengths permitted an essentially equilibrium study of both plasma heating and other effects due to neutral beam injection. Both coinjection (beam parallel to the discharge current) and counterinjection (anti-parallel to the discharge current) were studied. Injection perturbs the plasma density and hence the electron-ion heat transfer, an effect which must be taken into account in evaluating the ion heating due to beam power input. The observed ion temperature increases with coinjection are in agreement with theoretical predictions both in magnitude (DELTA T/sub i//T/sub i/ ranging from 40 to 10 percent) and in scaling with plasma density. Measurements of parallel and perpendicular beam ion energy distributions are in agreement with theory, indicating little charge-exchange beam power loss, an effective ionic charge (Z) approximately 4, and significant beam energy transfer to the plasma. While net electron heating is sometimes observed with coinjection, the main effect of injection on electrons is to alter the radial distributions of electron temperature and density. Counterinjection was found to be much less effective than coinjection in plasma heating and to have a generally deleterious effect on the discharge parameters, stability, and confinement. (auth)

5129 ATOMIC NEUTRALS AND IMPURITIES IN THE TFR DEVICE. (CEN, Fontenay-aux-Roses, France). pp 127-133 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

The results given in this report are concerned in particular with a discharge at I_p = 200 kA, B_T = 40 kG in hydrogen (diaphragm ϕ_0 = 400 mm). The radial profile of the neutral density $n_{H0}(r)$ at 180° of the diaphragm gives a central density of 10^8 cm^{-3} and a peripheral density (r = 17 cm) of 7×10^6 cm^{-3}. In the case of the impurities, a series of measurements was made for three values of the plasma current I_p (100, 200, 300 kA). The main impurity is oxygen. The surface density of the ion O^{5+} is from 1 to 2×10^{12} cm^{-2} for the three currents. The surface densities of the ions Mo^{12+} and Fe^{14+} are lower by a factor of 10 to 100. The carbon content varies greatly, depending on the series of experiments. Z_{eff} as determined from the conductivity is close to 6 for discharges in hydrogen, regardless of the value of I_p on the plateau. For deuterium, Z_{eff} is of the order of 4 for 200 kA, and increases to 5.5 for 315 kA. If one considers only the ion O^{8+}, a Z_{eff} of 6 corresponds to an O^{8+} ion content of 9% in relation to the electron density. The results lead to a model in which the ions from O^{+} to O^{5+} are localized in a peripheral layer in which the confinement time is short (~1 ms). The flux of O^{6+} ions towards the center, which indicates, after ionization to the state O^{8+}, the proportion of this ion present at the end of the discharge, is a small part of the peripheral flux deduced from line radiance measurements. (auth)

5130 PLASMA HEATING WITH AN AZIMUTHALLY NON-SYMMETRICAL ION CYCLOTRON WAVE IN TOKAMAK TM-1-HF. Vdovin, V. L.; Rusanov, V. D.; Shapotkovskii, N. V. (Inst. of Atomic Energy, Moscow). pp 217-225 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

With the aid of a non-symmetrical system, an ion-cyclotron wave with m = 1 and λ_z = 30 cm was excited and identified in hydrogen, deuterium and helium in Tokamak TM-1-HF. The optimum absorption areas with respect to concentration and magnetic field were determined. In the absence of a magnetic beach, up to 200 kW HF power was introduced into the plasma. The maximum increase in nT according to the diamagnetic signal in the deuterium was 2×10^{15} eV/cm^3 with a concentration of $n \approx 10^{13}$ cm^{-3} and initial pressure 10^{15} eV/cm^3. Evaluation of the rise in ion temperature from the carbon impurity line yielded approximately 80 to 90 eV. (auth)

5131 HIGH-FREQUENCY PLASMA HEATING EXPERIMENTS IN THE TOKAMAK FT-1. Golant, V. E.; Gladkovskii, I. P.; D'yachenkov, V. V.; Larinov, M. M.; Leven, L. S.; Nikhailov, E. A.; Rozhdestuenskii, B. B.; Serebren'yii, G. A.; Shcherbinin, O. N. (Ioffe Inst. of Physics and Tech., Leningrad). pp 231-239 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

The absorption of electromagnetic wave energy at the lower hybrid resonance frequency can be used for heating plasma in toroidal traps. Transformation of the electromagnetic wave into plasma oscillations at the lower hybrid resonance frequency provides an absorption mechanism which remains highly efficient even at high plasma temperatures. In the vicinity of the lower hybrid resonance there is also strong collisional absorption. The authors describe experiments carried out in the Tokamak FT-1. Power of up to 40 kW was applied to the plasma at a frequency of 280 MHz and satisfactorily absorbed over a broad range of plasma densities. The heating effect, however, as determined from the diamagnetism, was small. The life-time of the energy applied during high-frequency heating was not greater than 100 μs, whereas for ohmic heating it can attain values of 450-750 μs. High-frequency oscillations in the plasma produce fast ions with energies of up to 3 keV, but their lifetime is short—40-50 μs. The authors suggest that the high-frequency oscillation energy is absorbed by the cold plasma close to the antenna without reaching the lower hybrid resonance region. This may be due to collisional absorption in the external plasma layers. The generation of fast ions, however, indicates a considerable effect of non-linear processes in the high-frequency wave field that may be due to parametric instability. The short life-time of the fast ions can be explained in these conditions by the fact that they are formed in the external layers of the plasma. Parametric instability and collisional absorption resulting in dissipation of the high-frequency energy in the external plasma layers may accordingly be an obstacle to the use of the lower hybrid resonance for plasma heating. (auth)

5132 INVESTIGATION OF THE ELECTRON ENERGY DISTRIBUTION FUNCTION AND ITS VARIATION DURING ELECTRON CYCLOTRON RESONANCE HEATING. Alikaev, V. V.; Bobrovskii, G. A.; Poznyak, V. I.; Razumova, K. A.; Sokolov, Yu. A. (Inst. of Atomic Energy, Moscow). pp 241-254 of Plasma

Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Microwave heating on Tokamak TM-3 continues to be studied. The electron energy distribution function has been examined by means of x-ray and microwave plasma diagnostics. Variations in the spectral radiation pattern during auxiliary heating show a region of the distribution function where interaction with electromagnetic waves takes place, giving rise to diamagnetic effects observed previously. (auth)

5133 MAGNETOACOUSTIC HEATING OF PLASMA IN TOKAMAK TO-1. Ivanov, N. V.; Kovan, I. A. (Inst. of Atomic Energy, Moscow). pp 255-263 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

The results of experiments on the excitation and absorption of inherent magneto-acoustic oscillations of the plasma column in Tokamak TO-1 as well as the influence of these oscillations on the plasma state are presented. A loop exciter connected to a fixed frequency generator was used to achieve a hf-power input to the plasma. The plasma oscillations were recorded by a magnetic probe and the Q-factor of the plasma resonator was determined from the probe signal. The resonator is a measure of the dissipative capacity of the plasma. The low level of absorption measured (Q-factor = 5000) is associated with the ion viscosity mechanism. Excitation of magneto-acoustic oscillations in Tokamak TO-1 is accompanied by doubling of the plasma diamagnetism, outward shift of the plasma column, and increase in the current of the equilibrium regulators. In addition, the temperature of the plasma ion component was observed to increase from 100 to 170 eV. This was recorded from the Doppler broadening of the carbon impurity line C V and by measuring the energy distribution of the charge exchange atoms. Observation of particle and energy balance showed that magneto-acoustic oscillations exert a twofold influence on the plasma state. Firstly, all the dissipated energy is expended on heating the plasma ions. Secondly, the presence of oscillations results in an additional increase in the plasma energy content due to increase in the energy lifetime of the electrons as well as increase in the diffusion lifetime of the plasma. The latter is attributable to the stabilizing effect of magneto-acoustic waves on the instability responsible for anomalous electron thermal conductivity and plasma diffusion in the tokamak. (auth)

5134 PRODUCTION OF A HOT ION PLASMA AT THE LOWER HYBRID RESONANCE AND MEASUREMENT OF ITS PARAMETERS. Glagolev, V. M.; Dyubailov, A. G.; Krivov, N. A.; Martynenko, V. V.; Skosyrev, Yu. V. (Inst. of Atomic Energy, Moscow). pp 267-280 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Electromagnetic fields delayed along a magnetic field have been created within a plasma with the aid of a loop encircling the plasma column. When these waves propagated transversely in relation to the magnetic field within a plasma with density rising along its radius they were delayed in the direction of propagation. The amplitude and phase distribution of the electromagnetic fields along the radius of the plasma column was measured at different instants of time. The existence of an absorption band of these waves within the plasma was detected. The absorption band was shifted toward the outer boundary from the plasma when plasma density was increased. By four independent methods it was established that the gas-kinetic pressure of the plasma, measured on the basis of its diamagnetism, is determined by the ion component. It was found that the energy of ions at right angles to the magnetic field is considerably less than the ion energy. The cause of limited heating was an increase in density and energy losses in the charge-exchange process. To improve vacuum conditions, the loop encircling the plasma was placed in a metallic chamber, and the ultrahigh-frequency plasma source used in the original experiments was replaced by a film-hydride source. This made it possible to increase the internal energy of the plasma to 3×10^{15} eV · cm^{-3} at a density of $(1\text{-}3) \times 10^{12}$ cm^{-3}. The mean energy of atoms leaving the plasma at right angles to the magnetic field as a result of charge exchange reached 1 keV. The region of change in plasma parameters (density and magnetic field) for which heating was observed corresponded to the linear transformation theory. Non-linear effects could occur only in the first stage of heating, when the electric fields were strong, but plasma temperature was low. Heating efficiency was measured by a reflectometer installed in the co-axial line connecting the generator and HF input coil to the plasma. The measurements showed that ≈20% of the power generated is consumed in heating the plasma. (auth)

5135 THEORETICAL STUDIES OF PLASMA CONFINEMENT IN MAGNETIC MIRRORS. Rensink, M. E.; Fowler, T. K.; Freis, R. P. (Univ. of California, Livermore). pp 311-319 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

The plasma confinement parameter (n tau) and the maximum beta consistent with ideal MHD stability are computed for various values of the mirror ratio R and ion-source injection angle θ_0. The mathematical model that yields this information is the velocity-space Fokker-Planck equation for the ion and electron distribution functions. For an idealized plasma configuration, the modification of the magnetic field due to finite beta is calculated. The computation of self-consistent, finite-beta plasma equilibrium is given with application to mirror magnetic wells. The omnigenous nature of some non-axially-symmetric cells is illustrated, and the results of solving magnetic differential equations on a Eulerian grid to compute field line integrals are shown. (auth)

5136 INTENSE-NEUTRAL-BEAM RESEARCH AND DEVELOPMENT. Baker, W. R.; Berkner, K. H.; Copper, W. S.; Ehlers, K. W.; Kunkel, W. B.; Pyle, R. V.; Strarns, J. W. (Univ. of California, Berkeley). pp 329-337 of Plasma physics and controlled nuclear fusion research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

The LBL "10-ampere" source, which delivered 10-A, 20-keV, 20-ms deuterium beams into the LLL 2XII mirror experiment, has been scaled up by a factor of 5. This "50-ampere" source and its operation are discussed in some detail. It produces a 10-ms, 20-keV deuterium ion beam of approximately 75 A (1.5 MW), which is converted to energetic neutrals with about 90 percent efficiency in a close coupled neutralizer; 67 equivalent amperes (1.34 MW) of ions and neutrals are delivered in $+\text{-}2^0 \times +\text{-}4^0$, of which 47 A (0.94 MW) are within $+\text{-}1^0 \times +\text{-}2^0$. Some of the modifications of the original 10-A source are discussed, too: the use of curved grids to decrease beam divergence, the addition of vanes to reduce gas flow from the source, and staging to higher energies by adding another 7 x 7 cm electrode to give two accelerator gaps in series. Finally, progress in the computational program on the optimization of ion extractors is briefly described. (auth)

5137 PLASMA CONFINEMENT IN A PR-7 TRAP. Gott, Yu. V.; Ioffe, M. S.; Kanaev, B. I.; Motlich, A. G.; Pactukhov, V. P.; Sobolev, P. I. (Inst. of Atomic Energy, Moscow). pp 341-354 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

The PR-7 is a mirror trap with minimum-B created by a quadrupole system of stabilizing conductors. Plasma is injected by an intensive plasma-beam discharge. The range of parameters of the studied plasma is as follows: initial density $n_0 = (2 \text{ to } 3) \times 10^{12}$ cm^{-3}, mean ion energy $\overline{W}_i \approx 400$ eV, and electron temperature $T_e = 7\text{-}10$ eV; the magnetic field in the center of the trap is $B_0 = 5.0$ kOe, the longitudinal mirror ratio is 2.0, and the transverse depth of the magnetic well is up to 30%. The work is directed primarily at elucidation of the reasons for the sharp increase in plasma losses which develops within a certain period following the end of injection within a decaying plasma. This effect was detected earlier in the PR-6 apparatus, and subsequently in the PR-7, and its study was touched on in several papers. One of the main unsolved problems is why the high-loss stage is delayed relative to the moment where injection is stopped for a period of time that is definite and easily reproducible in different experiments. The present work establishes a number of new facts that shed light on this question: (a) It was found that this delay coincides with the time taken for the plasma to be re-arranged into an equilibrium configuration from the non-equilibrium configuration it assumes during injection; (b) the rapid increase of plasma potential observed in the PR-7 coincides with the moment when the re-arrangement of the plasma configuration is completed; (c) on transition from the initial, slow stage of decay to the high-loss stage, the frequency spectrum of the recorded oscillations ex-

tends from the ion-cyclotron frequency ω_B down to the region of lower frequencies and, what is particularly important, the oscillations lose their periodicity and become extremely irregular. This is crucial to an understanding of the high-loss mechanism since it shows that the losses are directly related to the occurrence of strong turbulence in the plasma after it attains MHD-equilibrium. (auth)

5138 PLASMA CONFINEMENT IN THE OGRA-3 SIMPLE MIRROR TRAP IN THE PRESENCE OF A MULTI-ELEMENT FEEDBACK SYSTEM. Zhil'tsov, V. A.; Likhtenshtein, V. Kh.; Panov, D. A.; Kosarev, P. M.; Chuyanov, V. A.; Shcherbakov, A. G. (Inst. of Atomic Energy, Moscow). pp 355-368 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

The Ogra-3 apparatus is a simple magnetic mirror trap with a 2.1 mirror ratio and a central magnetic field of up to 25 kG, specially constructed for conducting investigations into plasma stabilization without the aid of feedback circuits. Plasma is obtained within the Ogra-3 via injection into a vacuum of a beam of hydrogen atoms with energy of 20 keV and intensity greater than 50 equiv. mA. The vacuum conditions assure a lifetime of around 0.1 s before charge exchange for the fast ions captured in the trap. Without special measures being taken, the plasma within the Ogra-3 is unstable with respect to hydromagnetic flute oscillations, which restrict plasma build-up near the instability threshold at densities of $1\text{-}2 \times 10^8$ cm^{-3}. To stabilize the flute instability, an electrostatic, 12-electrode feedback system with Fourier dimensional synthesis (analysis) was created, which suppresses the lower space modes of flute instability. Using this system it was possible to raise the threshold density at which losses appear by a factor of 10 and to observe the excitation and stabilization of the higher modes of flute instability. Experiments with the 12-electrode system showed that the previously observed reduction in losses with positive transfer coefficients of the feedback system is not due to stabilization of the flute instability but to non-linear effects, specifically a reduction of the phase velocities of unstable waves and attenuation of their interaction with the confined fast ions. These experiments also demonstrated the existence of a stability region with negative transfer coefficients, a region which had been predicted theoretically but was not observed in earlier experiments with stabilizing systems having a small number of stabilizing electrodes. The dispersion characteristics of a plasma in the presence of a feedback system were investigated and compared with theory. Three branches of flute instabilities were observed, as predicted by theory, and the variation of these under the effect of feedback was studied. (auth)

5139 STUDY OF HOT-ELECTRON PLASMA IN THE CIRCE MINIMUM-B MAGNETIC CONFIGURATION. Bardet, R.; Briand, P.; Dupas, L.;Gormezano, C.; Melin, G.; Werkoff, F. (CEN, Grenoble, France). pp 371-378 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

It is shown that the hot-electron plasma obtained in the Circe experiment may constitute a plasma target well suited for producing hot plasma by injecting fast neutrals. This plasma target, obtained by trapping plasma injected into a mirror and heated to the electron cyclotron resonance, can be used to obtain quality factors (relation between density n of the plasma and density n_0 of the residual neutral gas) that are sufficiently high to satisfy the neutral pressure requirements for good neutral injection. On the theoretical side, the influence of the ambipolar potential during injection of the neutral was studied, and it is seen that the transition of a plasma dominated by hot electrons ($T_e/T_i >$ 100) to a hot-ion plasma ($T_e/T_i \sim 0.2$) corresponds to a maximum in the evolution of the potential. On the experimental side, modifications of the HF power injection have led to improvements in operating pressure in comparison with previous experiments. The value of n_0 is obtained by an absolute measurement of the intensity of H_β line. At a resonance frequency of 8 GHz, we let the HF power vary between 1 and 20 kW. With 10 kW, the following results are obtained: $\beta = 16\%$, $n = 5 \times 10^{11}$ cm^{-3}, $T_e = 85$ keV, $T_i = 270$ eV, $n/n_0 \gtrsim 100$ and $\tau \sim 4$ ms. During plasma decay, the functional dependence of $n\tau$ on T_e and T_i is compatible with that of a plasma subject to the classical losses. Measurements were also made at a resonance frequency of 16 GHz. (auth)

5140 PLASMA PRODUCTION AND CONFINEMENT IN THE BASEBALL II MIRROR EXPERIMENT. Anderson, O. A.; Birdsall, D. H.; Damm, C. C. (Univ. of California, Livermore). pp 379-389 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

The problem of plasma build-up in a steady-state magnetic-mirror field is being explored in the Baseball II experiment. Methods under investigation utilize neutral-beam injection either with or without a target plasma. Results are reported for build-up starting from a high vacuum, without a target. To reduce the likelihood of microinstability, an ion distribution broadened by Coulomb scattering is obtained. With injection at energies less than 2 keV in a high-vacuum environment, the mirror losses were found to substantially exceed charge-exchange losses, indicating a broadened ion distribution. However, the threshold density for ion-cyclotron instability was no higher than in previous experiments that were dominated by charge exchange. The onset of instability is observed to depend on beam geometry, and instability signals are usually absent shortly after beam injection ceases. The spatial and temporal distribution of anomalous losses is related to potential perturbations rotating at frequencies near the ion grad-B drift. Anomalous losses increase rapidly as the injected beam increases, limiting the density to $3\text{-}5 \times 10^9$ cm^{-3}. A pulsed hydrogen discharge in minimum-B geometry for use as a target plasma was also investigated. Densities of 10^{13} to 10^{14} cm^{-3} have been measured in a 5-cm-diameter discharge with electron temperature of 5-15 eV. Calculations show satisfactory hot-plasma build-up with 50-A pulsed injection. (auth)

5141 LASER-INITIATED TARGET EXPERIMENT (LITE). Haught, A. F.; Ard, W. B.; Fader, W. J.; Jong, R. A.; Mensing, A. E.; Polk, D. H.; Tomlinson, R. G.; Woo, J. T. (United Aircraft Research Labs., East Hartford, CT). Contract AT(11-1)-2277. pp 391-399 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

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The UARL Laser Initiated Target Experiment (LITE) is investigating the use of neutral beam injection onto a high-density target plasma to create and sustain a hot, dense, steady-state plasma in mirror geometry. The moderate-temperature (less than or equal to 1 keV), high-density, mirror-confined target plasma for this program is generated by laser beam heating of a small, solid particle of LiH within a minimum-B magnetic field. The LITE system is designed to inject a 0.5 A equivalent beam of 10 keV H^0 neutrals onto the approximately 100 cm^2 projected area of the confined target. Fokker-Planck and rate-equation calculations show that the target plasma will be heated by charge exchange and maintained by ionization of the injected beam to form a steady-state injection-sustained 10-keV plasma at a density greater than 10^{12} cm^{-3}. (auth)

5142 ELECTROSTATIC TRAPPING OF HIGH-Z IMPURITY IONS, AND ALPHA-PARTICLE DIFFUSION IN TOKAMAK REACTORS. Hazeltine, R. D. (Univ. of Texas, Austin); Ware, A. A.; Sigmar, D. J.; Hirshman, S. P.; McCune, J. E.; Crume, E. C.; Hogan, J. T.; Clarke, J. F. Contract AT(11-1)-3070. pp 589-603 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.1); CONF-741105-P1.

New neoclassical effects are reported which result from the nonuniform density of impurity ions on a magnetic surface. Nonuniformity arises partly from toroidal effects directly and partly from the associated electrostatic potentials. There is a new pinch effect involving passing particles and a corresponding bootstrap current. There is no increase in electron diffusion; the diffusion driven by the friction of the new bootstrap current is cancelled by the interaction of the Pfirsch-Schlueter current with the variable part of the resistivity. At the high collision frequency end of the plateau regime the pressure gradient needed to balance the combined pinch effects is substantially increased; this will help explain the increase in -dT/sub e//dr with decreasing radius observed in ST. Thermalized alpha-particle and fuel ion diffusion in a reactor-like tokamak plasma is investigated. The coupled continuity equations for n/sub alpha/ and n/sub i/, with the fluxes GAMMA/sub alpha/ and GAMMA/sub i/ given by a previously developed impurity theory in the banana regime, are discussed analytically and solved numerically. If the superthermal alpha-particles remain near their birth-flux surfaces during slow-down, n/sub alpha/ is strongly coupled to n^2/sub i/ (sigma /sub f/v) and gamma/sub alpha/ is outward, GAMMA/sub i/ inward. This enables refueling from the edge. If the shape of

n/sub alpha/ is decoupled from n^2/sub i/ (sigma/sub f/v), GAMMA/sub alpha/ is inward and GAMMA/sub i/ outward, until Taylor's impurity equilibrium is reached. Using distributed refuelling sources, one can nevertheless achieve steady state profiles with tolerable alpha-particle concentration. (auth)

5143 DISTORTION OF THE PLASMA ION DISTRIBUTION DURING NEUTRAL INJECTION HEATING. Cordey, J. G. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 623-632 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Mechanisms which lead to the distortion of the background ion distribution during neutral injection heating are described. The presence of the injected fast ions themselves causes the ion distribution to be distorted at energies above 7 kT_i for present tokamaks. The preferential heating of the ions in the tail of the background ion distribution by either the injected ions or higher temperature electrons is also found to give rise to a small distortion. (auth)

5144 NEUTRAL BEAM INJECTION INTO TOKAMAKS. Callen, J. D.; Colchin, R. J.; Fowler, R. H.; McAlees, D. G.; Rome, J. A. (Oak Ridge National Lab. TN). pp 645-658 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.1); CONF-741105-P1.

The theory of the plasma modifications induced by neutral beam injection into a tokamak is developed in detail. The system is treated as a three-component plasma: fast ions, background plasma ions and electrons. The fast-ion treatment includes: (1) the initial fast-ion spatial distribution; (2) energy and momentum transfer from the fast ions to the background plasma ions and electrons in the presence of impurities, charge exchange and an electric field; (3) a loss region in velocity space due to drift orbits that make large outward radial excursions for certain pitch-angle ranges; and (4) pitch-angle scattering into the loss region during the fast-ion slowing-down process. The degree to which this fast-ion component can model alpha particles in a reactor is discussed. The changes that the momentum and energy inputs from the fast ions induce in the plasma transport equations are derived. The resultant macroscopic plasma perturbations are calculated and, except for the density change, found to compare favorably with experimental results. The profile changes induced by the current perturbation and central electron heating complicate the analysis and comparison with experiment. (auth)

5145 NEOCLASSICAL DIFFUSION AND THE INFLUENCE OF α-PARTICLES ON THE ENERGY BALANCE IN LARGE TOKAMAKS AND FUSION REACTOR PLASMAS. Duechs, D. F.; Pfirsch, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 669-680 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Classical collision theory is used to develop models for the behavior of α-particles in fusion plasmas. A kinetic equation for the distribution function F_α (E; $\vec{x}$,t) is presented, E being the kinetic particle energy. The dependence of F_α on configuration space is given in terms of, for example, neoclassical fluxes (in the banana regime) which have to be calculated for several groups of α-particles. These groups are defined by approximating F_α with a sum of Maxwellian distributions. Here the fluxes for one group have been evaluated. Numerical solutions for homogeneous as well as constant radial profile plasmas using data from a European reactor design study suggest three groups of α's. Even with an enhancement of the neoclassical fluxes by a factor of 100, only about 10% of the α-particles produced is lost after 17 s in the one-group model, which overestimates diffusion. This indicates that a steady-state reactor will hardly be feasible. (auth)

5146 NUMERICAL STUDY OF SOME PROPERTIES OF A PLASMA CONFINED IN A LARGE TOKAMAK. Girard, J. P.; Marty, D. A.; Moriette, P. (CEN, Fontenay-aux-Roses, France). pp 681-696 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

A numerical study is made of some properties that should be exhibited by a plasma confined in a large Tokamak designed for studying the possibilities of ignition. The effects of the presence of impurities on the energy balance are emphasized, and the power that would have to be supplied in addition to the ohmic power to achieve ignition is calculated. It is shown that an energy gain can be expected if this power is supplied by the injection of fast neutrals, thanks to the thermonuclear reactions produced by the beam. The authors warn, however, against the severe consequences of poor neutral beam capture, which is profoundly affected by the impurity ions. The properties of the plasma are compared in the case of two density profiles, one flat, the other with a peak. The one with a peak appears to present a number of advantages, both during ohmic heating and upon neutral injection. The calculations show that the best profile can be obtained either by using a mobile diaphragm or by adiabatic compression of the small radius of the plasma obtained by increasing the value of the toroidal field with time. (auth)

5147 PARTICLE AND ENERGY CONTAINMENT IN THE WII-b STELLARATOR. Hacker, H.; Pacher, G.; Renner, H.; Rehker, S.; Ringler, H.; Wuersching, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 3-11 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

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The WII-b machine is an Ohmically heated stellarator (with l = 2, m = 5 helical windings) with a major radius R = 0.5 m and a plasma radius a = 0.5 m. The experiments reported here have been performed in hydrogen and helium gas. The energy confinement times are shown to be consistent with a heat loss process dominated by pseudoclassical heat conduction. The particle containment time is in the neighborhood of neoclassical values. (auth)

5148 TURBULENTLY HEATED TORSATRON EXPERIMENT. Hamberger, S. M.; Sharp, L. E.; Malein, A.; Bradley, J.; McKay, W. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 21-32 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Preliminary results are given on the formation and gross behavior of a plasma column whose boundary is defined by the magnetic separatrix of the confining 10 kG torsatron field and which carries an "Ohmic heating" current. The electron temperature rises to ~200 eV at a density ~10^{13} cm^{-3}. The maximum vacuum transform t = 0.8 is at the separatrix. When the current is such as to increase the surface transform to t = 1 the plasma column demonstrates disruptive behavior. By applying a strong pulsed electric field ||B anomalously low conductivity whose value is consistent with earlier experiments at lower magnetic fields is demonstrated. (auth)

5149 ION VELOCITY DISTRIBUTION IN A TOROIDAL PLASMA WITH LARGE LARMOR RADII. Stringer, T. E. (EURATOM-UKAEA, Abingdon, Eng.). pp 33-43 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The neoclassical theory of diffusion in a toroidal plasma assumes that ρ_θ, the ion Larmor radius in the poloidal magnetic field, is less than r_n, the density scale length. The breakdown in this analysis at larger ρ_θ/r_n is found to be associated with distortion of the ion velocity distribution from Maxwellian. Ions whose parallel velocities lie within the resonant band escape because of ∇B drift. If collisional scattering into this velocity band is unable to balance the enhanced radial diffusion, a minimum develops in the velocity distribution. This happens when $\epsilon\rho_\theta/r_n > (r\nu_i/v\Theta)^{\frac{1}{2}}$, where $\epsilon = r/R$, $\Theta = B_\theta/B_\varphi$, and ν_i is the ion collision frequency. When $\epsilon\rho_\theta/r_n > (r\nu_i/v\Theta)^{\frac{1}{2}}$ the distribution has a loss-band character. The stability of such an anisotropic velocity distribution to the electrostatic modes is investigated. Only the plateau collisional regime is studied. Although the predicted anisotropy is weak for typical tokamak parameters, it can be large for stellarators. Observations in the Proto-Cleo stellarator are consistent with theoretical predictions. (auth)

5150 CONFINEMENT OF PLASMA WITH LOW COLLISION FREQUENCY IN STELLARATORS WITH SHEAR. Voitsenya, V. S.; Voloshko, A. Yu.; Solodovchenko, S. I.; Suprunenko, V. A.; Tolok, V. T.; Shtan, A. F. (Physical-Technical Inst., Kharkov).

pp 63-73 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

This is a survey of experimental research on the confinement of low-density plasma in stellarators, when the main contribution to diffusion is due to particles blocked in the helical inhomogeneities of the magnetic field (frequency range $\nu_e < \nu_{e2}$, where $\nu_e = \nu_{ee} + \nu_{ei} + \nu_{en}$, and ν_{e2} is the lower boundary of the plateau on the dependence of the diffusion coefficient on collision frequency). Only results obtained in stellarators with relatively large shear are examined. A comparison of the experimental data with the existing theories of diffusion in systems with helical symmetry is presented. It is shown that in all cases the measured dependences of diffusion coefficients on collision frequencies are weaker than the neoclassical theory predicts; if these dependences are given in the form $D_{\perp exp} \sim \nu_e^{-\gamma}$, then for all the investigated devices ("Proto-Cleo," "Saturn," "Vint-20" ("Helix-20"), "Spac-1," and "Heliotron D") the value of γ proves to be less than unity. An empirical correlation was found between the value of γ and the parameters of the boundary magnetic surface of the apparatus. On the basis of an analysis of the data concerning plasma confinement in the "Saturn" stellarator, it was concluded that in this device (where $\gamma \approx 0.1$) in the region of low collision frequencies, at least up to $0.1\ \nu_{e2}$, a plateau-characteristic dependence of the reduced plasma life-time on the rotational transform angle and the magnetic field is observed: $\tau/r_0^2 \sim t_0 H_0^2$ (τ is the measured confinement time; t_0 and r_0 are the angle and radius of the outer magnetic surface; H_0 is the intensity of the confining magnetic field). Possible explanations for the differences between theory and experiments under consideration are discussed. (auth)

5151 PLASMA HEATING AND LOSSES IN TOROIDAL MULTIPOLE FIELDS. Armentrout, C. J.; Barter, J. D.; Breun, R. A. (Univ. of Wisconsin, Madison). pp 89-96 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

The heating and loss of plasmas have been studied in three pulsed, toroidal multipole devices: a large levitated octupole, a small supported octupole and a very small supported quadrupole. Plasmas are produced by gun injection and heated by electron and ion cyclotron resonance heating and Ohmic heating. Electron cyclotron heating rates have been measured over a wide range of parameters, and the results are in quantitative agreement with stochastic heating theory. Electron cyclotron resonance heating produces ions with energies larger than predicted by theory. With the addition of a toroidal field, Ohmic heating gives densities as high as 10^{13} cm^{-3} in the toroidal quadrupole and 10^{12} cm^{-3} in the small octupole. Plasma losses for n equals 5×10^9 cm^{-3} plasmas are inferred from Langmuir-probe and Fabry-Perot interferometer measurements, and measured with special striped collectors on the wall and rings. The loss to a levitated ring is measured by using a modulated light beam telemeter. The confinement is better than Bohm but considerably worse than classical. Low-frequency convective cells which are fixed in space are observed. These cells around the ring are diminished when a weak toroidal field is added, and loss collectors show a vastly reduced flux to the rings. Analysis of the spatial density profile shows features of B-independent diffusion. The confinement is sensitive to some kinds of d. c. field errors, but surprisingly insensitive to perturbations of the a. c. confining field. (auth)

5152 DIFFUSIONS OF dc OCTOPOLE PLASMAS IN THE TRAPPED-ELECTRON REGIME. Tamano, T.; Hamada, Y.; Moeller, C.; Ohkawa, T.; Prater, R. (General Atomic Co., San Diego, CA). Contract AT(04-3)-167. pp 97-102 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Diffusions of collisionless plasmas were investigated in the dc Octopole. Three types of diffusions were observed in this regime. One is neoclassical diffusion which occurs at low electron temperatures (T/sub e/ less than 0.5 eV) and low poloidal magnetic fields. Another diffusion is thermal fluctuation diffusion which takes place when the plasma dielectric constant is small, i.e., in low densities and high magnetic fields. When electrons are heated above 0.5 eV, the third diffusion mode appears. The plasma lifetime in this mode is proportional to the reciprocal of the electron temperature and to the strength of the poloidal magnetic field, but is independent of plasma density and the toroidal magnetic field. Thus, the diffusion is called "poloidal Bohm" diffusion since the scaling is similar to Bohm scaling except it has the strength of the poloidal magnetic field instead of the total magnetic field. The magnitude of the plasma lifetime is 500 approximately 1000 times longer than a "poloidal Bohm time". Judging from the magnitude of the diffusion coefficient, the cause of this diffusion is likely to be a weak turbulence due to the presence of trapped electrons. It is also noted that the poloidal Bohm scaling seems to fit the results of plasma confinement times of tokamaks and spherators. (auth)

5153 PLASMA CONFINEMENT IN A HYBRID STELLARATOR WITH l = 2 AND l = 3 HELICAL FIELDS. Miyamoto, K.; Fujiwara, M.: Kawahata, K.; Terashima, Y.; Dodo, T.; Yatsu, K. (Nagoya Univ., Japan). pp 115-122 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The dependence of plasma transport on rotational-transform angle and shear as well as on the plasma parameters is studied in the JIPP Ib stellarator which is equipped with both l = 2 and l = 3 helical windings. Afterglow plasmas produced by electron cyclotron resonant heating and P.I.G. discharge are used. The properties of the resonant losses observed in afterglow plasma in the rational cases of the l = 2 stellarator field are investigated, and the shear effect on the resonant losses is examined by superposing the l = 3 helical field. It is found that the plasma loss is due to the onset of a dissipative drift instability including toroidal effects. The observed properties of the fluctuations such as frequency, wave propagation, etc. can be explained by this instability. Introduction of weak shear (shear length $L_s \sim 300$ cm) reduces the resonant loss in our experimental conditions. When the instability is suppressed, the confinement time becomes long ($\tau \simeq 60 \sim 200$ ms, $T_e = 0.6$ eV, $B_t \simeq 0.8 \sim 3$ kG). Ohmic plasma heating is carried out with a programmed vertical field for the equilibrium case. The density is about 5×10^{12} cm^{-3}, and the conductivity temperature is about 120 eV. The plasma current is limited by $(\iota_l + \iota_h)/2\pi < 0.5$ where ι_l and ι_h are, respectively, the rotational-transform angles due to plasma current and helical field when $\iota_h/2\pi < 0.5$. The confinement time is about the pseudo-classical one. (auth)

5154 TOKAMAK OF SMALL ASPECT RATIO WITH MULTIPOLE FIELD (ASPERATOR T-3). Nagao, S.; Watanabe, H.; Funato, Y.; Fujino, Y.; Sakamoto, I.; Sugita, K.; Goto, Y. (Tohoku Univ., Sendai). pp 123-128 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The plasma production by a tokamak-type device of small aspect ratio with a multipole field as magnetic plasma limiter, Asperator T-3 (major radius 27 cm, minor plasma radius about 17 cm, and, therefore, aspect ratio about 1.6) is studied. A peak discharge current of up to 100 kA is obtained with a one-turn voltage of 90 V in helium gas of filling pressure 5 to 10×10^{-4} torr. The electron conductivity temperature on the column axis is estimated to be about 16 eV. (auth)

5155 CONFINEMENT AND ION-CYCLOTRON-HEATING EXPERIMENTS WITH OHMICALLY HEATED PLASMA IN THE HELIOTRON-D. Uo, K.; Iiyoshi, A.; Obiki, T. (Kyoto Univ.). pp 129-137 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Experimental studies on plasma confinement and ion cyclotron heating in the Heliotron-D are described. The observed particle confinement is in good agreement with neoclassical theory. The maximum mean free path reaches values of the superbanana regime, but localized particle diffusion has not yet been observed. The particle confinement times are measured in the case of large Ohmic heating current ($0.4 \lesssim q_{OH} \lesssim 1.5$) and considerably high β ($0.2\% \lesssim \beta \lesssim 3\%$), and no enhancement of particle diffusion has been observed. As for ion cyclotron heating in a strongly inhomogeneous magnetic field, an increase in ion temperature of up to 10 eV is attained at power level of 100 kW. (auth)

5156 PLASMA CONFINEMENT AND HEATING IN THE ELMO BUMPY TORUS (EBT). Dandl, R. A.; Eason, H. O.; Guest, G. E.; Hedrick, C. L.; Ikegami, H.; Nelson, D. B. (Oak Ridge National Lab., TN). pp 141-149 of Plasma Physics and Controlled

Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

The ELMO Bumpy Torus (EBT) is a toroidal magnetic trap in which microwave heating is used to produce steady-state, high-beta plasmas. The confined plasma consists of an annular, mirror-confined, relativistic-electron component localized near the midplane of each of the 24 identical sectors of EBT; and a less energetic circulating ("toroidal") component with more nearly isotropic pressure. The plasma is formed and heated (and maintained in steady state) by two 18-GHz klystron amplifiers producing 30 kW (cw); two travelling-wave amplifiers at 55 GHz producing 10 kW (cw); and 5 kE (cw) additional power at 10.6 GHz. Depending on ambient gas pressures, three distinct modes of plasma behaviour are observed: a cold-plasma mode (C-Mode) at high pressure; a quiet mode with significant stored energy at intermediate pressures (T-Mode); and a mode with large stored energy but high fluctuation levels at low pressure (M-Mode). In the T-Mode typical parameters are: for the toroidal component: n/sub e/ approximately 1-3 x 10^{12}/cm^3; T/sub e/ greater than 100 eV; T/sub i/ less than 75 eV; for the annular component: n/sub e/ approximately equal to 8 x 10^{10}/cm^3; T/sub e/ approximately equal to 900 keV; beta approximately equal to 0.4. The observed stability is consistent with a body of theoretical results developed for EBT while the observed confinement suggests that neoclassical transport mechanisms may dominate in the T-Mode, where observed particle-replacement times are 10's of milliseconds. (auth)

5157 BEAM AND HIGH-FREQUENCY HEATING OF A PLASMA IN TOKAMAK-TYPE SYSTEMS. Ivanov, A. A.; Parail, V. V.; Soboleva, T. K.; Yushmanov, P. N. (Inst. of Atomic Energy, Moscow). pp 203-220 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The authors present a theoretical treatment of non-Ohmic methods of plasma heating. The interaction between a plasma and a magneto-acoustic wave of fairly high amplitude and a frequency lower than that of the lower hybrid resonance is studied. It is shown that, owing to the effects of decay and induced scattering, the magnetoacoustic wave can effectively give off its energy to electrons and ions. It is also found that such a wave can suppress long-wave drift instabilities, thereby increasing the electron energy lifetime. A two-dimensional partial numerical modelling method has been used as a basis for analyzing the interaction between a fast ion beam and a plasma. It is shown that the ion beam generates in the plasma oblique ion-acoustic oscillations whose backward action on the beam cause its angular deflection. The characteristic times of beam deflection have been determined, together with the time of establishment and shape of the stationary spectrum of ion-acoustic turbulence. (auth)

5158 MULTI-KILOJOULE SHORT-PULSE GLASS LASER AND ITS USE IN HIGH-TEMPERATURE PLASMA HEATING. Mallozzi, P. J.; Epstein, H. M.; Jung, R. G.; Applebaum, D. C.; Fairland, B. P.; Gallagher, W. J.; Campbell, B. E. (Battelle Memorial Inst., Columbus, OH). pp 479-485 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The paper discusses a neodymium-doped glass laser that routinely produces 1400 J in a pulse width of 3.5 ns, and has delivered 1200 J to copper and iron slab targets to produce up to 200 J of x-rays. The laser employs a double-pulsing technique that doubles the effective power of the six final parallel stages. The double-pulsing technique is a special example of a multiple-pulsing technique that circumvents the self-focusing limitation of high-power lasers for fusion research. The x-ray measurements are also discussed and the results are analyzed with the help of a theoretical model and computer code for a non-equilibrium high-Z radiative plasma in the laser focus. (auth)

5159 EXPERIMENTAL STUDY OF PARAMETRIC INSTABILITIES AND ANOMALOUS HEATING IN PLASMA. Batanov, G. M.; Rabinovich, M. S. (Lebedev Inst. of Physics, Moscow). pp 625-640 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Over the last few years the study of the dissipation of electromagnetic wave energy in a hot plasma has become perhaps one of the main problems of hot plasma physics and controlled thermonuclear fusion. The focus of attention is on the processes by which electromagnetic energy is transformed into potential plasma waves and the processes involving relaxation of the latter. In this paper the authors summarize the experimental research into these processes conducted at the Lebedev Physics Institute over the 10 cm wave band. In the case of an isotropic plasma the authors recorded nonlinear generation of Langmuir noise, the energy density of which was found to be comparable, in order of magnitude, with that of a pump wave. They detected the generation of fast electron streams, the non-stationary character of the latter with respect to time, and nonlinear transillumination of the plasma layer. In the case of a magnetoactive plasma they studied the parametric excitation of oscillations at the upper hybrid frequency during its resonance with the first overtone of the pump wave. At the same time as excitation of the plasma noises they detected generation of fast electron streams, in the energy spectrum of which they recorded separate groups. It was also found that the effective collision frequency increases by 1-3 orders, compared to the pair collision frequency. In the region of magnetic waves close to the electron cyclotron resonance the authors observed forced Mandelstam–Brillouin scattering and kinetic instability of the plasma. It was found that the excitation of Langmuir ion noises preceded "anomalous absorption" of waves and "anomalous heating" of electrons. The authors further consider the possibility of an experimental study of anomalous heating in plasma in the region of the lower hybrid frequencies, using the Institute's L-2 stellarator. (auth)

5160 PLASMA DIFFUSION IN TOROIDALLY LINKED MIRROR SYSTEMS. Cordey, J. G.; Watson, C. J. H. (EURATOM-UKAEA, Abingdon, Eng.). pp 643-652 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

It is shown that, in a toroidally linked mirror (TLM) system, the particle drift surfaces are almost independent of energy but strongly dependent on the pitch angle (a situation which contrasts with that in toroidal confinement systems which possess magnetic surfaces). Both trapped and passing particles lie on closed and approximately superposable surfaces; however an intermediate class of particles with pitch angles lying in a "risk disc" have drift surfaces which are either closed but highly distorted or open. Diffusional plasma loss is typically due to repeated angular scattering into this risk disc, leading to loss by a radial random walk process. The dependence of the loss rate on the parameters of the system is derived in three different collisional regimes. An estimate is given of the overall energy amplification factor Q of a fusion reactor based on this containment concept. (auth)

5161 ADIABATIC rf-PLUGGING SCHEME FOR A CONTROLLED FUSION REACTOR. Hatori, T.; Watanabe, T.; Obayashi, H. (Nagoya Univ., Japan). pp 663-670 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The concept of adiabatic rf plugging applied to the cusp system has been investigated both theoretically and experimentally. In the line and point cusps, the plasma dimension across the magnetic field can be about as small as the ion Larmor radius. In such thin plasmas, the rf electric field can be excited efficiently. The condition for the rf field to form a quasi-potential barrier against a charged particle is discussed theoretically. The structure of this quasi-potential is also demonstrated by various experiments done with a simple cusp device. Based on these features, a new scheme for a plasma confinement system, composed of a straight cylinder terminated by magnetic cusps with adiabatic rf plugs, is proposed as a possible prototype of the fusion reactor. This system is characterized by moderate operating temperature, impurity-free confinement, and no loss cone instabilities. The power balance problem is considered. (auth)

5162 COMPRESSION OF A DENSE TOROIDAL PLASMA WITH A $\beta > 1$ GAS PISTON. Kurtmullaev, R. Kh.; Lunin, A. L.; Semenov, V. N. (Inst. of Atomic Energy, Moscow). pp 753-762 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

The authors consider the possibility of considerably reducing the total energy in a thermonuclear system with non-magnetic confinement, and also alternative methods of heating a plasma. In the proposed system a plasma with a magnetic field forms a closed toroidal configuration, thereby eliminating the longitudinal heat losses typical of open systems. In the process the formation of the toroidal structure and initial heating up to $\sim T \sim 1$ keV occur at parameters normal for a gas discharge ($n_0 \sim 10^{16}$ cm^{-3}). A further improvement in the parameters of the plasma can be obtained by increasing the pressure of the cold confining gas outside it. This is done either by pumping a further amount of cold gas into the plasma chamber or by compressing the plasma by means of a three-dimensional converging heavy sheath. The authors make numerical calculations of the compression dynamics of a plasma confined by the gas, with allowance for the cooling due to thermal conductivity and radiation. The calculations show that a positive thermonuclear yield can be attained in a system with pressure $P \sim 10^3$-10^4atm and dimension $L \sim 50-70$ cm. (auth)

5163 PLASMA CONFINEMENT IN A MULTI-MIRROR MAGNETIC FIELD. Budker, G. I.; Danilov, V. V.; Kornilov, V. A.; Krugleyakov, E. P.; Luk'yanov, V. N.; Mirnov, V. V.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 763-776 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

This paper contains a report of studies on the confinement of dense plasma carried out at the Nuclear Physics Institute during the past year. In comparison with first experiments on the device with alkali plasma, considerable advances in the area of short free path lengths ($\lambda \lesssim l$) have been successfully accomplished at the present time. It has been shown that, with free path lengths λ approximately equal to the length of the individual magnetic mirror trap (probkotron) l, the concentration ratio at the inlet and outlet of the system ceases to obey the exponential law, observed in previous experiments with low densities ($\lambda \gg l$). It has been established that, with free path lengths $\lambda \sim l$, the concentration ratio is at a maximum, attaining a value which is numerically in good agreement with the estimate obtained theoretically given a mirror ratio $K = 1.83$. Apart from stationary distributions, analysis was also made of non-stationary phenomena occurring when the plasma current is switched on or off rapidly. It was demonstrated, in particular, that a stationary plasma flow through a multi-mirror configuration was established considerably after the transit times. The mechanism for forming plateaux on oscillograms was clarified, illustrating the dependence of plasma density on time. Data on plasma decay after rapid disconnection of the cesium current were analysed. Plasma flow along a slightly corrugated field formed the subject of a separate analysis. Theoretical analysis, based on the slight density drop recorded in these experiments, yielded a satisfactory explanation for the effects observed. In conclusion, the new device GOL-1 built at the Nuclear Physics Institute to investigate multi-mirror confinement of hydrogen plasma with parameters $T \simeq 100$ eV, $n \simeq 10^{15}$ cm^{-3} is described. (auth)

5164 LASER HEATING OF A TRANSPARENT MEDIUM CONTAINING RANDOM ABSORBING INHOMOGENEITIES. Tribel'skii, M. I.; Grosberg, A. Yu. Zh. Eksp. Teor. Fiz.; 68: No. 3, 1060-1065(Mar 1975). (In Russian)

Heating of a transparent medium with randomly distributed absorbing particles of arbitrary size by laser radiation is considered. The probability distribution of the temperature field arising in the medium is calculated. It is shown that under real conditions it is not Gaussian and is mainly determined by large-size particles. The shape of the distribution does not depend on heat exchange conditions at the boundary of the body. (auth)

5165 ALPHA PARTICLE ENERGETICS AND NEUTRAL BEAM HEATING IN TOKAMAK PLASMAS. Mcalees, D. G. Madison, WI; Univ. of Wisconsin (1974). 144p. University Microfilms Order No. 74-27,750.

Thesis (Ph. D.).

In this work two key physics areas fundamental to tokamak plasmas have been analyzed in detail. Both center around plasma and particle dynamics and are critical to the success of deuterium-tritium fueled fusion power systems as they are presently envisioned. The energetic aspects of the 3.5 MeV alpha particles produced in D–T fusion events are examined and physical phenomena which can be expected to occur in future devices containing alphas are predicted. The model of the alpha particle dynamics includes toroidal magnetic field gradient and curvature drifts and motion along the magnetic field lines. Guiding center motion of alpha particles in various size plasma systems is analyzed. A model is developed to determine the energy density deposition rate profiles for neutral beam injection into a tokamak. The heating profiles in the background plasma due to neutral beam injection and alpha particle production are coupled to study the startup of a large CTR reactor. A two-fluid space time computer model is used to simulate the overall plasma behavior. The simulation model includes neoclassical ion conduction, pseudoclassical electron conduction, electron-ion rethermalization, bremsstrahlung and synchrotron radiation, ohmic heating, alpha particle and neutral beam heating terms. Questions of beam energy deposition profiles, energy requirements for neutral penetration into the plasma, and beam power required to achieve ignition or prescribed heatup rates are examined. The analysis is primarily for the 5000 MW(th) conceptual fusion reactor UWMAK-I studied by the University of Wisconsin. Typically, beam energies of several hundred kilovolts and powers of approximately 50 MW provide adequate penetration and ignition times in the range of 2 to 10 seconds. The sensitivities of the time required to achieve ignition and resulting heatup rates to changes in injection energy (100 to 500 keV) and beam power (10 to 75 MW) are also determined. (Diss. Abstr. Int., B)

5166 THEORETICAL STUDY OF A SPHERICAL INERTIAL ELECTROSTATIC PLASMA CONFINEMENT DEVICE. Swanson, D. A. Urbana, IL; Univ. of Illinois (1975). 103p. University Microfilms Order No. 75-14,177.

Thesis (Ph. D.).

A theoretical analysis was made of the negative potential well formed by electron injection and the multiple potential structure formed by electron-ion injection in spherical geometry. Poisson's equation has been modified to include spreads in the particle's total energy, as well as spreads in their angular energy. Solutions were obtained in the electron injection case for both rectangular and Boltzmann energy distributions that agree well with experimental data obtained from a spherical electrostatic confinement device. It is shown that a potential well is formed that has an approximately parabolic radial dependence whose depth depends essentially linearly on injected current and whose depth is relatively independent of the anode voltage for a constant anode current. (Diss. Abstr. Int., B)

5167 MASS ANALYSIS OF LOW-ENERGY IONS IN THE BASEBALL II PLASMA CONTAINMENT EXPERIMENT. Goodman, R. K. (Univ. of California, Livermore). Nucl. Fusion; 15: No. 4, 643-650(Aug 1975).

In a magnetic mirror plasma experiment, the plasma containment time is often limited by the charge exchange of energetic plasma ions with thermal gas. The low-energy ions that result from the charge exchange are not trapped by the magnetic field, but emerge through the mirrors and follow the field lines with an energy of the order of the plasma potential. Mass identification of these ions helps in locating and eliminating the source of the charge-exchange gas. To perform this identification, a modified quadrupole mass spectrometer is operated in the fringe magnetic field of the Baseball II plasma experiment. From the resulting spectra an estimate is made of the density of each component of the thermal gas. For various experimental conditions of Baseball II, component density estimates and time-resolved mass analyses are given. The mass spectrometer and its operation are also described. (auth)

5168 MEASUREMENT OF THE ENERGY BALANCE IN ATC TOKAMAK. Hsuan, H.; Bol, K.; Ellis, R. A. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 4, 657-661(Aug 1975).

Gross properties of the energy balance in the ATC tokamak were investigated. During the quasi-steady state phase of a normal discharge, the major part of the energy loss was found to be to the limiters. Radiation and charge-exchange play minor roles during this quasi-steady state phase, but are nevertheless the dominant loss mechanisms at the termination of a discharge and account for a substantial portion of the stored poloidal magnetic energy associated with the plasma current. (auth)

5169 PRESSURE PROFILES IN A THERMONUCLEAR PLASMA SHEATH CONTAINING ENERGETIC ALPHA-PARTICLES. Enoch, J. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 15: No. 4, 671-675(Aug 1975).

The pressure balance equation for a plasma sheath made up of fictitious fuel ions, electrons and alpha-particles is solved. The ions are assumed to be electrostatically confined which turns out to imply quasi-neutrality for sufficiently diffuse boundaries. The alpha-particles are assumed to satisfy the Vlasov equation and to be produced mono-energetically with a spatial source distribution proportional to the square of the fuel ion density. The final steps of the calculation are performed numerically and results for a few sets of parameters are shown. The alpha-particle pressure is

dominant in all regions of space for cases of practical interest. (auth)

5170 CREATION OF TRANSIENT HIGH-DENSITY PLASMAS BY CONVERGENT NEUTRAL BEAMS. Post, R. F.; Marx, K. D.; Eggens, C. J. (Univ. of California, Livermore). Nucl. Fusion; 15: No. 4, 701-703(Aug 1975).

The technique uses an array of inwardly directed pulsed neutral beam sources located on a spherical surface. The beam is programmed so that particles launched late in time tend to catch up with earlier ones. Calculations of beam dynamics are given. (MOW)

5171 QUASI-LINEAR THEORY OF PLASMA DOUBLE ION-CYCLOTRON RESONANCE HEATING. Dolgopolov, V. V.; Hussein, A. M.; Khalil, S. M. (Atomic Energy Authority, Cairo). Nucl. Fusion; 15: No. 4, 663-670(Aug 1975).

Heating of the ion component of a radially nonuniform plasma cylinder under the condition of double ion gyroresonance is studied in the quasi-linear approximation. An equation is derived for the diffusion of ions in velocity space; the radial distribution of the absorbed power is also obtained. The thermal energy of the ions is shown to increase even in plasma regions where the work of the electromagnetic field done on ion electric current is negative. The efficiency of the method of ion heating under the condition of double ion gyroresonance is compared with that of the method of "magnetic pumping." (auth)

5172 CURRENT BUILD-UP IN A PLASMA DISCHARGE WITH A MOVING LIMITER. Bardotti, G.; Enriques, L.; Santini, F. (CNEN-EURATOM, Frascati, Italy). Nucl. Fusion; 15: No. 4, 621-629(Aug 1975).

The problem of plasma-current build-up in a tokamak discharge is studied for the case of an expanding plasma column. A model is considered in which the thermal conductivity is pseudo-classical and a particle flux is assumed at the plasma boundary such that the density in the column remains constant. A class of analytical solutions for the evolution in time of the current and temperature profiles is found which reduces the system of equations to a system in only one variable. These solutions are numerically analysed and relations are found between several plasma and discharge parameters, as the expanding time, the value of q, the net energy load on the limiter, the poloidal β, the transformer flux, etc. The appropriate normalizations of these parameters and their relations allow the discussion of different characteristics of the discharge and of its optimization with respect to the presence of the skin effect and to the energy load on the limiter. Good profiles are obtained for an appropriate choice of parameters and of the time laws for limiter motion and current rise. A numerical code is also used to extend the solutions out of the particular class considered and to test the results. (auth)

5173 THREE-COMPONENT TOROIDAL REACTOR. Cordey, J. G.; Core, W. G. F. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 4, 710-712(Aug 1975).

It is shown that fusion between counterstreaming beams of deuterium and tritium ions slowing down in a DT-background plasma can give a larger energy amplification factor, particularly for low-energy injection. This three-component scheme has several additional advantages: first, beams at the required injection energy 40 to 60 keV have already been developed; second, the neutralization efficiency at this energy is much higher than at the 100 to 200 keV injection energy of the two-component scheme, and; finally, the present generation of tokamaks could test this concept. (MOW)

Plasma Diagnostics

5174 (EUR-CEA-FC-766) PROSPECTS FOR ION TEMPERATURE MEASUREMENTS IN JET BY THOMSON SCATTERING OF SUBMILLIMETRE WAVES. Whitbourn, L. B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Mar 1975. 21p. (CONF-750243-1). Dep. NTIS (US Sales Only) $4.25.

From workshop on diagnostics and data acquisition for JET; Fontenay-aux-Roses, France (4 Feb 1975).

The use of Thomson scattering for measurements on the JET tokamak is discussed. The principal concern is the practical limitations imposed by the availability of high power pulsed sources and sensitive detectors, and noise due to plasma emission at submillimeter wavelengths. Coherent scattering from plasma waves (ion acoustic waves and electron drift waves) with millimeter and submillimeter waves is considered. (MOW)

5175 (LA-UR-75-1542) CHARACTERISTICS OF HIGH-DENSITY THETA PINCHES SEEDED WITH SELECTED HIGH-Z ELEMENTS. Thomson, D. B.; Jones, L. A.; Bailey, A. G.; Engleman, R. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750944-18). Dep. NTIS $4.00.

From 3rd topical conference on pulsed high beta plasmas; Abingdon, Oxfordshire, UK (9 Sep 1975).

Atomic processes in high-temperature plasmas are vital in controlled fusion research and in opacity calculations. A program at Los Alamos to observe radiation from a high-Z-seeded theta pinch has the goal of studying these processes. A 60-kV, 180-kJ capacitor bank, crowbarred at peak current, produced a B/sub z/ field of 90 kG at T/4 equals 3.0 mu s in a 25-cm-long, 8.2-cm-i.d. theta coil. The theta pinch, called Scyllar, has been operated with hydrogen, deuterium, or helium, seeded with a few percent of Ne, CO_2, $Fe(CO)_5$, or other elements. Radiation in the VUV range is observed with a 2.2-m grazing incidence vacuum spectrograph. Diagnostics have included pulsed laser holographic interferometry, time-resolved observations of He II 4686 A line profiles, and two-foil soft x-ray temperature measurements. For diagnostics development, the bank has been operated at 1/3 capacitance with a field of 45 kG at T/4 equals 2.0 mu s. Characteristics of the seeded plasmas are summarized. (auth)

5176 (LA-UR-75-2077) SIMPLE, VERSATILE SYSTEM FOR DIGITIZING AND REDUCING DATA IN PHOTOGRAPHIC FORM. Henins, I.; Marshalk, J.; Sherwood, A. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 7p. (CONF-751125-59). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The data reduction system used on the Implosion Heating Experiment at LASL is described. The large number of fast diagnostic signals being recorded on this small experiment makes direct analog to digital conversion impractical at the present time. Therefore data acquisition is by the usual Polaroid photographs of scope traces. These data are digitized and reduced using a system built around a Hewlett Packard Model 9830 desk calculator equipped with a digitizer and plotter. An optical arrangement is described which allows a scope trace to be conveniently digitized well within the accuracy required. The digitized data can be processed as necessary with the desk calculator, plotted as desired, and stored on a magnetic tape cassette. It is believed that this system has merit for other small experiments where simplicity and versatility are desirable. (auth)

5177 (SAND-75-5415) LASER VELOCIMETER DATA ACQUISITION, PROCESSING, AND CONTROL SYSTEM. Croll, R. H. Jr.; Peterson, C. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 8p. (CONF-750919-2). Dep. NTIS $4.50.

From 6th international congress on instrumentation in aerospace simulation facilities; Ottawa, Canada (22 Sep 1975).

The use of a mini-computer for data acquisition, processing, and control of a two-velocity-component dual beam laser velocimeter in a low-speed wind tunnel is described in detail. Digital stepping motors were programmed to map the mean-flow and turbulent fluctuating velocities in the test section boundary layer and free stream. The mini-computer interface controlled the operation of the LV processor and the high-speed selection of the photomultiplier tube whose output was to be processed. A statistical analysis of the large amount of data from the LV processor was performed by the computer while the experiment was in progress. The resulting velocities are in good agreement with hot-wire survey data obtained in the same facility. (auth)

5178 (UCID-16939) CALCULATIONS FOR X-RAY DIAGNOSTICS IN 2XIIB. Garner, G.; Logan, B. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Sep 1975. Contract W-7405-Eng-48. 57p. Dep. NTIS $5.50.

A calculation of x-ray emission in 2XIIB for various plasma models is presented, comparing T/sub e/ obtained from measured x-ray transmission through various foils to T/sub e/ obtained from Thomson scattering. The three models used are: pure bremsstrahlung radiation with a full Maxwellian electron distribution; bremsstrahlung, recombination, and line radiation with impurities and a full Maxwellian electron distribution; and bremsstrahlung, recombination, and line radiation with impurities and a cutoff electron distribution. The last model was found to give temperatures most consistent with Thomson scattering and absolute intensities consistent with the intensities measured, indicating impurities and ambipolar cutoffs for electrons are present in 2XIIB. (auth)

5179 THOMSON SCATTERING SYSTEMS FOR TURBULENT PLASMA DIAGNOSTICS. Muraoka, K. (Kyushu Univ., Fukuoka); Goto, S.; Satomi, N.; Iguchi, H.; Kawabe, T.; Mitarai, O. Rep. Res. Inst. Appl. Mech. (Kyushu Univ.); 22: 165-175(Mar 1975).

Two systems for Thomson scattering in infrared laser light are described, both designed for measuring electron temperature and

density and possibly the electron drift velocity of turbulently heated plasmas as functions of space and time. Some preliminary results obtained with these two laser scattering systems are presented. (auth)

5180 FRASCATI TURBULENT TOKAMAK EXPERIMENT (T. T. F.). Luppi, R.; Martone, M. (CNEN-EURATOM, Frascati, Italy). pp 227-230 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Reducing the H_2 filling pressure to 4×10^{-4} Torr, and improving the magnetic-field configuration, current pulses with a duration up to 0.4 ms have been obtained. The time behavior of the density measured with a 2-mm microwave interferometer shows that the maximum value for the density during the confinement phase is $3.6 \times 10^{+13}$ cm^{-3}. Using ruby-laser Thomson scattering, an electron temperature of less than 5 eV has been measured on the axis during the confinement phase. For the same discharge, the existence of an electron population having a temperature varying in time from 2.5 keV up to 4 keV has been inferred from soft x ray measurements using the absorber technique. Increasing the plasma current rise time, the electron temperature measured by laser scattering increases to more than 20 eV. (auth)

5181 STUDIES ON NONCIRCULAR CROSS-SECTION TOROIDS IN THE DOUBLET II AND IIA DEVICE. Ohkawa, T.; Baker, C. C.; Brooks, N. H. (General Atomic Co., San Diego, CA). pp 281-290 of Plasma physics and controlled nuclear fusion research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Studies of confinement of toroidal plasmas with noncircular cross sections have been carried out in the Doublet II device. The motivation for these studies is the expectation that noncircular cross-section devices can operate at significantly higher values of beta than circular cross-section devices. A requirement for the realization of this potential is that noncircular cross-section toroids must obtain values of the safety factor and the poloidal beta comparable to those obtained in circular cross-section toroids. The experimental results from Doublet II substantiate this expectation. Electron temperatures up to 1100 eV and ion temperatures up to 525 eV were measured, yielding values of beta in the range of 1 percent. These results were obtained for plasma currents in the range 90–210 kA and the toroidal magnetic field was below 10 kG. To obtain plasmas with noncircular cross sections, it is necessary to establish special boundary conditions for the poloidal magnetic field. These boundaries can be established by conducting walls (field shapers) or by field coils with properly controlled currents and voltages. Some aspects of plasma control are simplified by the use of field shapers, but little configurational flexibility is possible, and diagnostic access is difficult. Therefore the Doublet II device was modified by replacing the field shaper with field coils. The modified device, called Doublet IIA, has been completed and is in the early stage of operation. (auth)

5182 DETERMINATION OF THE FRACTION OF RUNAWAY ELECTRONS IN A HOT NON-MAXWELLIAN TOROIDAL PLASMA FROM THE X-RAY SPECTRUM. Abramov, V. A. (Inst. of Atomic Energy, Moscow). pp 659-665 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

An analysis is made of the influence of the choice of various approximations for the bremstrahlung cross-section from electron collisions on the form of the bremsstrahlung spectrum and on the possibility of determining the electron temperature, T_e. A numerical calculation of the X-ray spectra of a hot plasma, in the presence of a group of runaway electrons, is carried out. An exact formula is taken for the radiation cross-section — exact in the sense that relativistic effects are included, i.e. that arbitrary v/c is considered, although in the Born approximation $e^2/\hbar v \ll 1$. If the experimentally observed bremsstrahlung spectrum is compared with the family of curves obtained, the fraction of runaway electrons can be estimated if the temperature of the main group of electrons is known. The influence of runaway electrons on the possibility of measuring T_e, by the method of filters, is assessed. It is shown that the distortion caused by the runaway electrons can be considerable. (auth)

5183 HIGH-TEMPERATURE THETA-PINCH PLASMA INTERACTION WITH A SOLID PELLET. Nunnally, W. C. Lubbock, TX; Texas Tech Univ. (1974). 123p. University Microfilms Order No. 75-17,759.

Thesis (Ph. D.).

The interaction of a high temperature, theta pinch plasma with spherical, .2 mm diameter, polystyrene pellets was observed. The pellets are not displaced or completely vaporized after many half cycles of theta pinch action. The vaporized material remains mainly neutral in the center of the theta pinch plasma. The vaporized material is ionized, however, when a Q-switched ruby laser is focused on the pellet cloud. The engineering design and development of a small, fast, efficient theta pinch system including a low inductance, high current, high voltage dielectric switch is described. In addition, the design and application of Mach-Zehnder interferometry, image converter camera photography, a differential diamagnetic loop, soft X-ray foil absorption and spectroscopy as diagnostics for the plasma-solid interaction are discussed. (Diss. Abstr. Int. B)

5184 THOMSON SCATTERING STUDY OF COLLISIONAL SHOCK-HEATED PLASMAS. McNeill, D. H. New York; Columbia Univ. (1974). vp.

Thesis (Ph. D.).

Thomson scattering was used to obtain electron temperature and density profiles in deuterium plasmas produced by strong collisional shock waves. The transverse shock speeds were 3 to 25 cm/mu sec in 50 to 100 m Torr deuterium. Ruby laser light was incident at a right angle to the axis in the midpoint of the annular gap of an electromagnetically driven coaxial shock tube and scattered light was collected at 90 degrees. Plasma created by reflecting a strong shock from a dielectric wall was also studied. It is found that the plasma electron temperature (10-30 eV) is much less than the ion temperature (100-500 eV) as is predicted by theory for the early life of the plasma. Electron-ion Coulomb collisional temperature relaxation does not occur during the times of observation (3-4 mu sec). Electron heating in the plasma is caused primarily by Ohmic dissipation of currents in the shock structure and piston. Plasma densities (0.5-3.5 x 10^{16} cm^{-3}) agree well with shock theory predictions. For gas ionizing shocks, good agreement with collisional theory is found for the electron temperature. (Diss. Abstr. Int., B)

5185 COMPUTER PROCESSING OF PLASMA INTERFEROMETER SIGNALS. Cummins, W. F. (Univ. of California, Livermore). J. Comput. Phys.; 18: No. 1, 106-113(May 1975).

A set of FORTRAN IV routines are given that retrieves digitized signals from the data system magnetic tape and performs an analysis of interferometric signals. The use of this data analysis system has increased the overall sensitivity of the interferometer to the low 10^{10} cm^{-3} range. (MOW)

Plasma Kinetics (General)

5186 (COO-2218-40) COMMENTS ABOUT PROPOSED D-He^3 EXPERIMENTS IN THE TFTR. Hively, L. M.; Miley, G. H. (Illinois Univ., Urbana (USA)). 6 Oct 1975. Contract AT(11-1)-2218. 25p. Dep. NTIS $4.50.

D-He^3 experiments to simulate DT burns in TFTR have been proposed by members of the Fusion Studies Center at the University of Illinois. Some basic considerations, involved in planning these experiments, are discussed along with important results to be obtained from such measurements. It is argued that fusion-product orbits, instabilities, and other phenomena can be investigated by D-He^3 simulation of DT burns, before the TFTR is contaminated by tritium. This approach will allow changes in experimental design before subsequent DT burn studies. (auth)

5187 (JINR-P13-9132) VIOLATION OF SIMILARITY IN ELECTRICAL DISCHARGES IN GASES. Lozanskii, E. D.; Pontekorvo, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A new relationship for the first Townsend ionization coefficient was derived taking into account associated ionization processes in the gas. Results of calculations of the first ionization coefficient are presented. It turns out to be, that deviations from similarity laws in electrical discharges may be quite significant. This is in qualitative agreement with published experimental data. (auth)

5188 HIGH-CURRENT DISCHARGES IN THE TFR DEVICE. (EURATOM-CEN, France). pp 135-144 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Macroscopically stable discharges have been obtained in D_2 and H_2 up to currents of 300 kA and durations of 0.5 s, with a toroidal field of 50 kG. A servo control device ensures satisfactory plasma equilibrium. For I_p = 300 kA, the safety coefficient at the edge is q = 2.8; the average electron temperature $\overline{T}_e$ = 1 keV; the central ion temperature T_i = 850 eV (D_2) and 1 keV (H_2); the average electron density $\overline{n}_e = 4 \times 10^{13}$ cm^{-3}; the liner density of kinetic energy W = 22 J/cm (D_2) and 18 J/cm (H_2); the energy confinement time τ_E = 16 ms (D_2) and 11 ms (H_2). During the discharge W increases with the current. The numerical simulation of the discharges follows the experimental results, retaining classical behavior for the ions, but keeping the transport coefficient abnormal for the electrons. When $\overline{n}_e \lesssim 10^{13}$ cm^{-3} strong interaction of the plasma with the walls occurs between the toroidal field coils. The heating of the wall measured by infra-red television, the flux of particles striking the wall and the x-ray spectrum emitted at impact indicate that this interaction is caused by high-energy electrons ($\overline{E} \simeq 50$ keV) trapped in the local mirrors. The radiation spectrum of the plasma in the 50 to 400 GHz band and the correlation of this phenomenon with the flux of runaway electrons suggest that these high-energy electrons are heated by instability between the runaway electron beam and the plasma. (auth)

5189 SHAPE OF THE TRANSVERSE CROSS-SECTION OF A PLASMA COLUMN IN THE FINGER-RING TOKAMAK. Bortnikov, A. V.; Brevnov, N. N.; Gerasimov, S. N.; Zhukovskii, V. G.; Maksimov, Yu. S.; Pergament, V. I.; Romanovskii, M. K. (Inst. of Atomic Energy, Moscow). pp 147-159 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

It follows from theoretical calculations that, all other conditions being equal, the gain in discharge current density in the finger-ring tokamak, as compared to the tokamak with a circular section, is determined by the degree of elongation of the plasma column. The authors report experimental results relating to the shape of the plasma cross-section in the T-9 device (finger-ring tokamak), in which the plasma column was shaped solely by a copper casing. The size and shape of the cross-section were evaluated by measuring the spatial distribution of electron density and of the luminous intensity of certain spectral lines (H_β, C III, C V), and also from the distribution of the poloidal field near the casing. The experimental results show that during the shaping process the plasma column is elongated in a vertical direction, the semi-axis ratio being $b/a \geq 2$. At certain values of the discharge current and initial pressure of the neutral gas, there may also be two plasma columns, above and below the plane of symmetry. When the shaping process is complete, the elongation of the plasma section diminishes and there is a sharpening of the electron density distribution and discharge current density distribution profiles – in other words, there is a contraction of the plasma column as a function of discharge current, plasma density, and toroidal magnetic field. In the experiments described, the discharge current ranged up to 20 kA, toroidal magnetic field intensity up to 10 kG, and mean plasma density up to 3×10^3 cm^{-3}. (auth)

5190 ELECTRON RUNAWAY IN LT-3. Strachan, J. D.; Dewar, R. L. (Australian National Univ., Canberra). pp 171-178 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

The occurrence of electron runaway before the onset of the disruptive instability was examined experimentally for different machine parameters by inserting a tungsten wire into the plasma. The duration of electron runaway was found to be the duration of the collapse phase prior to the disruptive instability as predicted by the trapped-particle pinch effect. The runaway rate varied as expected with toroidal magnetic field and filling pressure. The runaway signals in the stable discharges are of the same order of magnitude as expected theoretically. The data can be interpreted as diffusion due to imperfections of the drift surfaces with an RMS radial step length of about 1 mm per transit of the torus. (auth)

5191 ELECTRON CYCLOTRON EMISSION FROM A TOKAMAK PLASMA: EXPERIMENT AND THEORY. Costley, A. E.; Hastie, R. J.; Paul, J. W. M.; Chamberlain, J. (EURATOM, Abingdon, Eng.). pp 185-189 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.I); CONF-741105-P1.

The first measurements of the power, polarization and frequency spectrum of the electron cyclotron emission from a tokamak plasma are presented. The radiation is not polarized, does not have the previously predicted spectrum, and under certain circumstances is an order of magnitude above the predicted power level. The results are interpreted in terms of a scrambling of polarization on reflection within the torus and in terms of the emission from supra-thermal electrons. (auth)

5192 HIGH- AND LOW-CURRENT-DENSITY PLASMA EXPERIMENTS WITHIN THE MIT ALCATOR PROGRAMME. Ascoli-Bartoli, U. (CNEN, Frascati, Italy); Bosia, G.; Boxman, G. pp 191-203 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

The operation of Alcator at relatively high magnetic fields (up to 60 kG) and with a plasma radius of about 9 cm has led to plasma currents up to 200 kA corresponding to poloidal fields up to 4.4 kG and average current densities near 750 A/cm^2. Pulses up to 300 ms have been obtained without a feedback system to maintain plasma equilibrium. Neutron production of 10 count/ms has been detected from deuterium plasmas for the entire duration of the best discharges. A relatively large range of plasma densities from 5×10^{12}/cm^3 upward has been reached. Peak electron temperatures up to 1.8 keV have been measured by laser scattering. The constancy of the average density, as of the soft X-ray emission, and the features of neutron emission during long discharges and when switching from deuterium plasmas to hydrogen and vice versa, are indications of a relatively low influx of high-Z impurities. Poloidal field fluctuations with m equals 4, 3, 2 are detected when q-values lower than 3 are obtained. The initial operation of the Rector device for the investigation of MHD-equilibrium and stability of plasmas with comparable dimension as Alcator but non-circular cross section has indicated that vertical elongation can be achieved while maintaining the plasma column position by a feedback system. (auth)

5193 ELECTRODYNAMIC ACCELERATOR PLASMA AND ITS USE IN RESEARCH ON CONTROLLED THERMONUCLEAR FUSION. Vasil'ev, V. I.; Gervids, V. I.; Zhitlukhin, A. M.; Lototskii, A. P.; Lyashenko, V. N.; Skovortsov, Yu. V.; Strunnikov, V. M.; Umrikhin, N. M.; Tserevitinov, S. S. (Inst. of Atomic Energy, Moscow). pp 741-752 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.2); CONF-741105-P2.

The stream characteristics of a powerful electrodynamic accelerator were investigated. It was shown that under ideal conditions the efficiency can reach several tens of per cent and that the total energy of the stream is equal to 20 kJ with a directional proton velocity of $\sim 10^7$cm/s. By comparing experimental observations with calculations, a model was found which made it possible to design an accelerator for specified plasma parameters. Preliminary experiments on plasma stream transport and injection into magnetic fields were carried out. It was found that the motion of a plasma with $n \sim 10^{15}$ cm^{-3}, $T_\perp \sim 20$ eV and $T_\parallel \sim 1$ keV in magnetic fields of 500 - 2000 G with a longitudinal gradient of up to 0.55 kG/cm is accompanied by longitudinal (i.e. in the stream direction) adiabatic compression and heating of the plasma. An increase in the gradient to more than 0.55 kG/cm accordingly leads to rapid magnetization of the plasma because of the appearance of an anomalous resistance. The range of fields and gradients covered allows the optimum conditions for transport and injection of the stream into the magnetic field to be described. (auth)

5194 NEITRAL'NYE TOKOVYE SLOI V PLAZME. (Neutral Current Layers in a Plasma). Basov, N. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). 168p. (In Russian).

Papers are presented reporting some recent theoretical and experimental studies on the formation conditions, structure, and stability of neutral current sheets in a plasma. Phenomena such as the acceleration of cosmic rays, solar chromospheric outbursts, magnetosphere substorms, and accelerated particles in laboratory discharges are examined in the light of these investigations. Topics covered include hydrodynamic plasma flows in a strong magnetic field, numerical integration of the magneto-

hydrodynamic equations in the neighborhood of the zero line of a magnetic field, and the kinetics of a neutral current sheet. Individual items are announced in this issue. (IAA)

For abstracts of individual papers see: 5195, 5196, 5204, and 6249.

5195 NEUTRAL CURRENT SHEETS IN LABORATORY AND SPACE PLASMAS. Syrovatskii, S. I. pp 3-13 of Neitral'nye Tokovye Sloi V Laboratornoi I Kosmicheskoi Plazme. Basov, N. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Formation of a neutral current sheet in a plasma with a strong magnetic field containing a zero line is considered, and the nature and stability of the sheet are discussed. Investigation of solar chromospheric discharges wherein large quantities of magnetic energy were transformed into the energy of charged particles led to research into developing plasma accelerators that cause energy to accumulate slowly in the vicinity of a current sheet and then to be rapidly released in such a way that a substantial portion of this energy is converted into the kinetic energy of accelerated particles. Characteristic values of temperature, plasma density and magnetic field intensity in space and laboratory plasmas being closely related, the ordered relationships between these phenomena were investigated. A quasi-stationary neutral sheet was produced by applying a homogeneous electric field along the axes of a magnetic quadrupole; the sheet was subsequently broken up by electric field impulses. Ion-acoustic distributions, due either to heating the plasma or escape of charged particles, appeared in the sheet. Problems encountered in analyzing the sheet are discussed. (IAA)

5196 EXPERIMENTAL STUDY OF FORMATION CONDITIONS AND SOME CHARACTERISTICS OF A NEUTRAL CURRENT SHEET IN A PLASMA. Frank, A. G. pp 108-166 of Eksperimental'noe Issledovanie Uslovii Vozniknovenila i Nekotorykh Kharakteristik Neitral'nogo Tokovogo Sloia V Plazme. Basov, N. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

Formation conditions for a neutral current sheet in the neighborhood of the zero line of a magnetic field are studied experimentally. It is shown that anomalous resistance of a plasma, arising due to the development of small-scale instabilities, hinders formation of a neutral sheet. However, turbulent conductivity may be increased by increasing plasma density. A method is described for creating a dense plasma in a quadrupole field. A neutral current sheet develops in the plasma when its conductivity attains a magnitude of about 10 to the 14th power CGSE. A neutral sheet, whose width exceeds its thickness by a factor of five, is obtained. The magnetic field on the boundary of the sheet increases by a factor of six in relation to the initial magnitude of the field - i.e., a high concentration of magnetic energy is attained in the current sheet. (IAA)

5197 STARK PROFILES OF HYDROGEN SPECTRAL LINES IN A PLASMA WITH LANGMUIR TURBULENCE. Oks, E. A.; Sholin, G. V. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 3, 974-986(Mar 1975). (In Russian)

Stark profiles of hydrogen spectral lines in a plasma are considered by taking into account the nonadiabatic action of Langmuir noise. It is shown that decrease of the atomic lifetime in a Stark state induced by Langmuir noise leads to two main effects: to the appearance of characteristic «reliefs» on the quasistatic profiles of the lateral components and to broadening of the central component. Both stochastic and regular plasma oscillations are considered and compared with available experimental data. It is shown that the measurement of «reliefs» on the line profiles can be used to determine such parameters of the turbulent plasma as density of noise energy and characteristic frequencies of nonlinear processes. (auth)

Plasma Kinetics (Experimental)

5198 (UCID-16944) SPECTRAL MEASUREMENTS OF ELECTRONS AND X RAYS EMITTED FROM PLASMAS PRODUCED USING A 1,06-mu m LASER. Tirsell, K. G.; Kornblum, H. N.; Catron, H. C.; Slivinsky, V. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $4.50.

Absolute spectral measurements were made of electrons escaping from plasmas produced by focusing 5-10 J, 50-100 ps, 1.06 mu m laser pulses on 10-mu m-thick Parylene disk targets. Nine spectral bands with 3 to 7.5 keV resolution were obtained from 30 to 190 keV with a 90^0-focusing permanent-magnet spectrometer and appropriately positioned silicon electron detectors. The x-ray spectra were measured simultaneously with the electron spectra by means of a K-edge filter technique. Elemental filters were chosen to provide nine spectral cuts from 1.5 to 88 keV. Silicon p-i-n diodes were used for the 1.5 to 17 keV portion of the spectrum and scintillator photomultiplier combinations for higher photon energies, with the 17-keV channel duplicated. Each channel had about 20 percent energy resolution, and the final spectra were unfolded by an iterative technique. (MOW)

5199 ANOMALOUS RESISTIVITY CAUSED BY CURRENT DRIVEN ION ACOUSTIC INSTABILITIES. Kawai, Y.; Hasegawa, M.; Nakashima, H. (Kyushu Univ., Fukuoka). Rep. Res. Inst. Appl. Mech. (Kyushu Univ.); 22: 127-134(Mar 1975).

Ion acoustic wave turbulence was produced in a current-carrying discharge-tube plasma, and electric conductivities of plasmas have been measured as a function of dc electric fields over the range 0.01 to 3 V/cm. Below 0.05 V/cm, the electric conductivity can be interpreted in terms of the collision time between electrons and neutral atoms. Above 0.05 V/cm, the conductivity decreases as the reciprocal of (electric field). (auth)

Plasma Kinetics (Theoretical)

5200 (CEA-CONF-3112) EQUILIBRIUM AND PERTURBATIONS IN PLASMA-VACUUM SYSTEMS. Mercier, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1974. 8p. (CONF-740760-1). Dep. NTIS (US Sales Only) $4.00.

From technical conference on optimisation technique; Novosibirsk, USSR (1 Jul 1974).

Theoretical descriptions are given for plasma-vacuum systems for the following three cases: (1) equilibrium with external conductors, (2) perturbed equilibria, and (3) neighboring equilibria. (MOW)

5201 (ORNL-TM-5153) MULTI-FLUID TOKAMAK TRANSPORT MODELS. Hogan, J. T. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 60p. Dep. NTIS $5.45.

The following topics are discussed: (1) development of one-dimensional transport codes, (2) description of tokamaks, (3) survey of codes, (4) commonly used moment equations, (5) relevant physical processes, (6) transport by collisional diffusion and turbulence, (7) methods used to solve the diffusion problem, (8) trapping and thermalization, (9) numerical treatment, (10) models for neutral gas, and (11) numerical solution. (MOW)

5202 (UCID--16947) BOUNCE-AVERAGED KINETIC EQUATIONS. Rensink, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

The purpose of this report is to summarize the equations and definitions which enter into the bounce-average kinetic description of a mirror-confined plasma. The effects of time- and space-dependent ambipolar potentials and magnetic fields, as well as anisotropic Rosenbluth potentials are considered. The final result is a bounce-averaged kinetic equation which is written in "conservation form". Boundary conditions and a "normal mode" equation are also given here. (auth)

5203 (UCRL--51820) SIMPLEX, A CODE FOR THE SOLUTION OF LINEAR PROGRAMMING PROBLEMS. Walker, H.; Hall, L. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract W-7405-Eng-48. 55p. Dep. NTIS $5.45.

A set of procedures is described for solution of a general linear programming problem that seeks to maximize the linear functional W equals/sup n/SIGMA/sub j equals 1/ c/sub j/x/sub j/ for coordinates x/sub j/ greater than or equal to 0, subject to m restrictions of the form/sup n/SIGMA/sub j equals 1/ a/sub ij/x/sub j/ less than or equal to b/sub i/ and l restrictions of the form/sup n/SIGMA/sub j equals 1/ a/sub ij/x/sub j/ equals b/sub i/. An LRLTRAN computer code, which performs the maximization, has been developed to follow these procedures and is also described. Illustration of the use of the simplex procedure is given. (auth)

5204 NUMERICAL INTEGRATION OF MAGNETOHYDRODYNAMIC EQUATIONS IN THE VICINITY OF THE ZERO LINE OF A MAGNETIC FIELD. Gerlakh, N. I.; Syrovatskii, S. I. pp 73-87 of Chislennoe Integrirovanie Uravnenii Magnitnoi Gidrodinamiki Dlia Okrestnosti Nulevoi Linii Magnitnogo Polia. Basov, N. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

Magnetohydrodynamic equations taking finite conductivity into account are numerically integrated in the case of an initially quiescent homogeneous plasma in a hyperbolic magnetic field near the zero line. Solution of linearized equations at a distance from the zero line is used to set up boundary conditions in the form of a cylindrical wave of potential disturbance converging

toward the zero line and generated by activating steady external electrical field directed along the zero line. It is shown that as the wave approaches the zero line it becomes nonlinear and leads to the formation of a thin current sheet. No indications are found for the formation of a system of slow shock waves corresponding to Petschek's model. As compared with the initial density, the plasma density increases within the limits of the current sheet and decreases beyond it. Plasma flows out along the sheet with a velocity approaching that of Alfven waves. Areas along the boundaries of the sheet have reverse current. (IAA)

5205 EQUILIBRIUM, PERTURBATION, AND EVOLUTION OF A PLASMA-VACUUM TOKAMAK SYSTEM. Mercier, C.; Soubbaramayer. (CEN, Fontenay-aux-Roses, France). pp 403-410 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

A method for calculating the external currents needed to put an axisymmetric tokamak of non-circular cross-section into equilibrium is presented. The code works well. A perturbation calculation allows the variations of these equilibria to be studied and the neighboring equilibria to be found. (auth)

5206 FREE-BOUNDARY MHD-EQUILIBRIA. Suzuki, Y. (Japan Atomic Energy Research Inst., Tokai); Kameari, A.; Ninomiya, H.; Masuzaki, M.; Toyama, H. pp 411-420 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Three procedures are presented for a systematic design of the maintaining fields of large shell-less tokamaks with circular or non-circular plasma cross-section. These steps are closely related to the free-boundary problems of MHD-equilibria, and for two of them new computational methods are developed. One is to calculate the maintaining fields for an axisymmetric toroidal MHD-equilibrium with the given plasma parameters which are required by experimental aims, and the other is to solve the plasma equilibrium problem under the given maintaining fields for the case without the shell. An application of these methods to a large shell-less tokamak with divertor hoops is described. (auth)

5207 FIXING OF CHARACTERISTIC POINTS AS A METHOD OF MAINTAINING A GIVEN TOPOLOGY FOR AN EQUILIBRIUM PLASMA CONFIGURATION. Zakharov, L. E. (Inst. of Atomic Energy, Moscow). pp 421-427 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

The author considers one of the methods of controlling the position and shape of the cross-section of an equilibrium pinch in tokamak-type systems with a non-circular cross-section. This method can be used as a basis for an automatic system of maintaining equilibrium with preset topology of the external magnetic surfaces, including configurations having an axisymmetric diverter. (auth)

5208 MHD-STABLE AXISYMMETRIC EQUILIBRIA. Lortz, D.; Nuehrenberg, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 439-447 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1.); CONF-741105-P1.

MHD-stable axisymmetric equilibria with a perfectly conducting wall at the plasma boundary are obtained by evaluating sufficient stability criteria. Exact equilibria are considered so that no expansions with respect to small parameters occur (e.g. no low-β expansion, no inverse aspect ratio expansion). Therefore, the main results are of a quantitative nature: stable equilibria with finite aspect ratio and β-value are found. It is shown for tokamak-like configuration that (a) stable equilibria with a β-value of 1% exist and (b) stable equilibria with an aspect ratio of 5 exist. (auth)

5209 DISRUPTIVE PROCESS IN THE DIFFUSE PINCH. Minardi, E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 485-494 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Starting from a cylindrical tokamak equilibrium with a peaked parabolic current profile, and considering helical perturbations, a class of nonlinear neighboring stable equilibria is shown to exist, corresponding to perturbations of the poloidal magnetic field only, which are localized in the current channel and are related to the inhomogeneity of the current. The perturbed poloidal flux is mainly independent of the helical coordinate and is a strongly increasing function of q_a, the value of the safety factor on the axis. A situation is considered in which q_a decreases as a consequence of external factors while the total current and the helical flux are conserved. Moreover, the conducting shell (if it exists) surrounding the plasma is slit in order that the magnetic flux can adjust to the new equilibrium. In such a situation a discontinuity, which occurs in the time derivative of the poloidal flux when q_a crosses the bifurcation points and the system assumes the new neighboring equilibria, gives rise to voltage spikes whose sign and magnitude are consistent with observations. The magnitude of the spikes is proportional to m^{-1}; for very peaked current profiles they occur at q_a values around one. After the spike, if q_a decreases further, the neighboring equilibrium develops, and the current profile tends to flatten. For $\dot{q}_a \approx -10^3$ s^{-1} the relaxation time is of the order of some tens of microseconds. In the present point of view, the short-time-scale process is just the consequence of the slow q_a (t) dependence associated with the strong q_a dependence of the stable neighboring equilibrium. (auth)

5210 STEADY-STATE CONVECTION AND ANOMALOUS TRANSPORT. Maschke, E. K.; Paris, R. B. (CEN, Fontenay-aux-Roses, France). pp 531-539 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Using the MHD equation with viscosity and resistivity and a heat transport equation, the authors investigate the steady-state convective motion of a weakly unstable plasma. Two situations are considered: constant temperature (pressure varying with density) and constant density (pressure varying with temperature). A simple case is the cylindrical plasma sheath, which is unstable because of the effect of an unfavorable curvature of the magnetic lines of force. The critical Rayleigh number for triggering the first convective radial mode is obtained for two simple pressure profiles and for different conditions at the limits. It is shown that convective motion can extend far beyond the unstable region. The perturbation amplitude is calculated by means of two nonlinear integral relations, and an expression of the anomaly factor of transport in the presence of convection is obtained. (auth)

5211 ANOMALOUS TRANSPORT PROCESSES IN HIGH-TEMPERATURE TOROIDAL PLASMAS. Coppi, B.; Pozzoli, R.; Rewoldt, G.; Schep, T. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3070. pp 549-559 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Significant transport processes resulting from the excitation of relatively small levels of fluctuations in confined plasmas are investigated in regimes where a fraction of the electron and/or ion population is trapped. When longitudinal electric fields of the order of the runaway field are applied, the trapped electron distribution remains locked in with the magnetic field, while the circulating electron distribution tends to run away from it and produces a distortion in the overall distribution. In particular, when a second peak is formed, low-frequency standing modes are shown to "resonate" with different portions of the distribution, and provide the momentum exchange between circulating and trapped electrons that is needed to produce an effective electrical resistivity. A depletion of impurity ions from the center of a plasma column is shown to be produced by impurity driven modes when a significant temperature gradient of the main ion population is present. This favorable effect is accompanied by ion thermal conductivity, across the magnetic field, enhanced over its collisional value. Particle and electron energy transport are produced by a new, "ubiquitous", mode that does not require a fraction of the ion population to be trapped, exists with or without a significant electron collision rate, and is driven by the electron temperature gradient or by the unfavorable magnetic curvature drift of the ions and trapped electrons, for proper values of the transverse wavelength. Finally, a spatially inhomogeneous hot ion population, resulting

from the injection of a beam of fast neutrals for the purposes of ion heating or tritium burning, is shown to induce collective modes which may enhance the rate of energy loss to the main ion population and induce particle transport across the magnetic field of the base plasma. (auth)

5212 EXTRACTION OF IMPURITIES FROM A TOKAMAK CONFIGURATION. Dei-Cas, R.; Samain, A. (CEN, Fontenay-aux-Roses, France). pp 563-570 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Three methods are considered for preventing contamination of Tokamak plasmas without using a divertor. A high thermal gradient should prevent the impurity ions from diffusing inwards in the realistic situation where the ions are in a Pfirsch-Schlüter regime and where the hydrogen ions are in a banana or plateau regime. Another possibility is to give the circulating hydrogen ions an ordered velocity along the lines of flux of the order of their diamagnetic velocity. Motion of this kind can be obtained by low-amplitude magnetic pumping. Finally, the authors discuss the use of an electric field oscillating at the cyclotron frequency of the impurity ions in such a manner that the ions acquire transversal energy, are trapped by modulation (assumed to be present) of the magnetic field and thus escape from containment. (auth)

5213 ACTION OF EXTERNALLY APPLIED FORCES ON THE MIGRATION OF IMPURITIES IN A TOKAMAK CONFIGURATION. Consoli, T.; Le Gardeur, R.; Tonon, G. F. (CEN, Grenoble, France). pp 571-587 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

The action of external forces on the impurities migration in a Tokamak is considered. Two different solutions are described. In the first, it is proposed to act on the neutrals and the impurities (emitted by the wall and by any solid element situated in low density plasma) after their ionization and before their diffusion in the dense plasma core. The external force in this case is due to the interaction with the plasma of an (E_r, B_θ) field with the B_ϕ magnetic field. This force imparts to the low density plasma a rotational motion and a centrifugal force which counteract the diffusion of impurities. The ejection out of the vacuum chamber of the impurities is obtained with the elastic reflection of the plasma particles on a mechanical deflector or with a crossed field deflector. The system acts as a "dynamic divertor". The electrons and ions of the deflected plasma flux are collected after separation. The second solution is based on the time average $\mu\nabla B$ force, which acts on the ions at the ion cyclotron resonance. This force is oriented parallel to the equatorial plane of the torus, and generates a vertical drift velocity which modifies the thickness of the banana orbits. This force influences also the repartition of the ions of same A/M and produces above a threshold of the applied R. F. electric field an enhanced diffusion towards the wall of the peripheral ions. (auth)

5214 EFFECTS OF IMPURITIES AND MAGNETIC DIVERTORS ON HIGH-TEMPERATURE TOKAMAKS. Meade, D. M. (Princeton Univ., NJ); Furth, H. P.; Rutherford, P. H.; Seidl, F. G. P.; Duechs, D. F. pp 605-621 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.1); CONF-741105-P1.

A one-dimensional tokamak plasma transport code was adapted to include impurity influx, stripping, radiation, and diffusion, as well as the usual processes of hydrogen plasma and heat transport, recycling at the boundary, and multi-generation charge-exchange. Neutral-beam heating, adiabatic compression, and divertor boundary conditions are included as optional features. Illustrative computations are given for present-day and next-generation tokamaks. The problems of impurity control are discussed, and two technical approaches are examined in greater detail: the transient cold-plasma shield, and the poloidal divertor. (auth)

5215 TRANSPORT AND DIVERTOR STUDIES IN THE FM-1 SPHERATOR. Ando, K.; Ejima, S.; Davis, S. (Princeton Univ., NJ). Contract AT(11-1)-3073. pp 103-114 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Fundamental problems of toroidal fusion devices were investigated in the FM-1 Spherator. These subjects include the transport due to drift-wave turbulence in the trapped-electron regime, poloidal divertor and impurities, and lower hybrid heating. (auth)

5216 THREE-DIMENSIONAL TOKAMAK EQUILIBRIA. Grad, H. (New York Univ.). pp 153-161 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Conventional tokamaks are low-beta and approximately axially symmetric devices. It is therefore appropriate to expand in beta about a simple toroidal closed-line vacuum field (B_0 approximately 1/r). To first order there is a force-free field (discharge parallel to B_0); only to second order does it support plasma. In other words, it requires a relatively large current, J approximately beta/sup 1/2/, to maintain the plasma in equilibrium. In a bumpy torus, on the other hand, it requires only a current J approximately beta to confine the plasma. The latter theory is also characterized by the fact that constant pressure contours approximate vacuum contours of constant q_0 equals integral dl/B_0. This is in contrast to the tokamak, where vacuum contours of q_0 are not confined. A theory of low-beta, tokamak-like equilibria is described which depart from an arbitrary closed-line vacuum field instead of the usual axially symmetric toroidal field. These equilibria span the range from linear (J approximately beta) bumpy torus scaling to quadratic (J approximately beta/sup 1/2/) bumpy tokamak scaling. These analytical formulations are appropriate for numerical calculation. (auth)

5217 THEORY AND NUMERICAL SIMULATION OF COLLECTIVE TRANSPORT OF PLASMA IN MAGNETIC FIELDS. Canosa, J. (Princeton Univ., NJ); Krommes, J.; Oberman, C.; Okuda, H.; Tsang, K.; Dawson, J. M.; Kamimura, T. pp 177-189 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

Numerical and theoretical studies were made on the transport of particles and heat in collisionless plasmas in magnetic fields for both quiescent and turbulent states. The following problems were investigated: (1) A systematic kinetic theory of hydrodynamic fluctuations in a strong magnetic field has been developed to study the particle diffusion due to thermal convective cells. (2) Effects of the density and temperature gradients on thermal convective cells; they are found to destabilize both the ion flute and the convective cells. (3) Effects of the mirroring magnetic field on convective diffusion; they are found to increase the diffusion significantly even for open field lines of force. (4) Turbulent electron heat transfer due to short-wavelength ion fluctuations near the lower hybrid frequency; this may be important in a collisionless plasma. (5) Heat transfer due to emission and absorption of electrostatic plasma waves are studied theoretically and by simulation; agreement has been found for a strong magnetic field case. (6) Particle diffusion in a toroidal magnetic field due to collisions (neo-classical diffusion) and due to collective effects is studied by numerical simulations. Neoclassical theory agrees well with the numerical results when the long-wavelength collective modes are suppressed. (auth)

5218 PLASMA IMPURITIES AND THEIR SIGNIFICANCE IN FUSION REACTORS. Behrisch, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.); Kadomtsev, V. V. pp 229-246 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.2); CONF-741105-P2.

Impurities, i.e. small amounts of high-Z atoms, in a hydrogen fusion plasma have several unwanted, but also stabilizing, effects. The main source of impurities is sputtering from the first wall by hydrogen and helium atoms. The best method of keeping the impurity concentrations low seems to be control of the plasma temperature near the first wall at a low level, i.e. 10 to 100 eV. A divertor may be necessary, mainly as an effective sink for the helium. Furthermore, low-Z material (oxide, carbide) with low sputtering yield may have to be chosen for the first wall. Several possibilities of influencing the impurity concentration are discussed. The problem seems to be not to avoid impurities completely, but to be able to control their concentrations. (auth)

5219 MHD STABILITY OF THE BOUNDARY LAYER IN GAS BLANKET SYSTEMS. Lehnert, B. P. (Royal Inst. of Tech., Stockholm). pp 717-723 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.2); CONF-741105-P2.

Full-scale quasi-steady fusion reactors are likely to operate in an ion density regime where the plasma is "impermeable" to neutral particles. A neutral gas blanket then develops between the plasma and the chamber walls, and is separated from the fully ionized plasma body by a partially ionized, dense, cool boundary layer of finite size. The dynamics of the plasma in this layer is strongly affected by the collision processes between various kinds of charged and neutral particles. For wave and instability modes of moderately high frequencies there is a strong plasma-neutral gas coupling, which is represented by a kind of compound plasma-neutral gas viscosity. A simple local-ized analysis indicates that flute-type perturbations should become completely stabilized by a joint viscosity-resistivity-pressure effect. If this result also becomes applicable to full-scale fusion reactors, it may provide an alternative to minimum average-B stabilization in the boundary layer, i.e. when such a stabilization becomes inefficient on account of incomplete magnetic line-tying. (auth)

5220 GUIDING-CENTER SIMULATION OF TOROIDAL PLASMAS. Johnson, T. H. Davis, CA; Univ. of California (1974). 294p. University Microfilms Order No. 75-15,438.

Thesis (Ph. D.).

A new computer simulation method for axisymmetric toroidal plasmas is developed. The method comprises two separate physical models representing different components of an experimental plasma. The first model is an MHD fluid equilibrium representation; the technique devised for the solution of this equilibrium is several times faster than any currently in common use. The second model is a macroparticle representation which uses guiding-center formalism for the particles' velocities and positions; consequently, the timestep used by this model may be many times longer than those possible for conventional macroparticle simulations. A new computer code, GUIDON, which incorporates these models with solution for self-consistent magnetic fields, is presented. Special features of the guiding-center model are discussed in detail. Results of simulations using GUIDON are also presented. The major effort involves design simulation of the proposed Two-Component Torus (TCT) prototype reactor. Further results describing the SPIRE toroidal electron pinch accelerator, the Ware drift in Tokamaks, and a Physics International Corp. electron beam drift torus are presented. (Diss. Abstr. Int. B)

5221 CONSERVATION FORM IN COMPUTATIONAL MAGNETOHYDRODYNAMICS. Lindemuth, I. R. (Univ. of California, Livermore). J. Comput. Phys.; 18: No. 2, 119-131(Jun 1975).

The question of whether or not to use a conservation form of the internal energy equation in computational magnetohydrodynamics is considered. Conservation errors resulting from both spatial and temporal difference methods are demonstrated, and means of eliminating the spatial errors and reducing the temporal ones are discussed. It is shown that only in the limit DELTA t yields 0 can a nonconservation form of the internal energy equation be used without destroying in the finite difference equations any of the conservation properties of the magnetohydrodynamic partial differential equations. (auth)

5222 SIMULATION OF COLLISIONAL EFFECTS IN PLASMAS. Rathmann, C. E.; Denavit, J. (Northwestern Univ., Evanston, IL). J. Comput. Phys.; 18: No. 2, 165-187(Jun 1975).

A computer simulation method was developed to simulate collisional effects in plasmas in the regime where plasma instabilities are dominant but are modified by weak collisions. The algorithm is based on the method of periodic smoothing in phase space, in which collisions are introduced at reconstruction times in terms of a one-dimensional Fokker-Planck operator with a velocity dependent collision frequency. The results of test problems, including approach to equilibrium, collisional heating, and plasma echo decay, are presented. (auth)

5223 RECOMBINATION MECHANISM OF THE THERMAL CONDUCTIVITY OF A PLASMA IN A STRONG MAGNETIC FIELD. Vekshtein, G. E.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1299-1303 (Apr 1975). (In Russian)

In the conventional theory of transport processes in a high temperature hydrogen plasma the latter is assumed to consist of only electrons and ions, i.e. to be completely ionized. The result is that transverse transport coefficients of a plasma in a magnetic field turn out to drop with increasing magnetic field strength and may become negligible in sufficiently strong fields. However, even in a high temperature plasma there is always an admixture of neutral hydrogen atoms produced as a result of recombination. Since the motion of the atoms is not affected by a magnetic field, a transport mechanism arises which is independent of the magnetic field intensity. This mechanism evidently defines the lower limit of the transport coefficients which is attained in sufficiently strong magnetic fields. The corresponding limiting values of the transport coefficients are calculated. It is shown that in a broad range of plasma parameters they exceed the classical values even in very moderate magnetic fields (H ~ 30 kG). (auth)

5224 INTERACTION OF HIGH-TEMPERATURE PLASMA WITH ELECTROMAGNETIC RADIATION IN A GRAVITATIONAL FIELD. I. General theory. Ignat'ev, Yu. G. (Kazan State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 7-15(1975). (In Russian)

On the basis of a linearized general relativistic kinetic equation, the interaction of high-frequency electromagnetic radiation with a completely ionized plasma in a gravitational field was examined. The pseudotensors of the complex conductivity, dielectric constant, and energy absorption were constructed. (tr-auth)

5225 INTERACTION OF HIGH-TEMPERATURE PLASMA WITH ELECTROMAGNETIC RADIATION IN A GRAVITATIONAL FIELD. II. Non-Relativistic Temperatures $K_bT_e < m_ec^2$. Ignat'ev, Yu. G. (Kazan State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 109-119(1975). (In Russian)

On the basis of the theory developed previously, the interaction of weakly relativistic plasma in a gravitational field with electromagnetic radiation was examined. The results were applied to plasma in a Schwarzschild field. The physical reasons for the occurrence of negative absorption were discussed. (tr-auth)

5226 ANOMALOUS PLASMA RESISTIVITY DUE TO ION-ACOUSTIC TURBULENCE. Orens, J. H. Princeton, NJ; Princeton, Univ. (1974). 141p. University Microfilms Order No. 75-6665.

Thesis (Ph. D.).

A multidimensional computer simulation study was made of the ion-acoustic instability (the relative electron-ion drift velocity is less than the electron thermal velocity) in the presence of collinear constant electric and magnetic fields, and an investigation of the anomalous d.c. resistivity due to its turbulence as a function of both these external fields. The constant electric field is in a regime greater than the Dreicer critical limit, but much less than a field which would accelerate an average electron to its thermal velocity in less than an ion plasma time. The constant magnetic field varies from zero to one for which the electron cyclotron frequency is approximately equal to the electron plasma frequency. Our analysis includes an investigation of the self consistent electric field fluctuations and the ion density turbulence, and we follow the evolution of the particle velocity distribution functions and phase spaces. A discussion is given of the electron and ion heating rates and the stabilization of the current. A detailed analysis is given of the simulation code and especially its level of classical resistivity is discussed. From this basic understanding one is able to determine the degree of resistivity enhancement. Finally the observations are compared to applicable nonlinear theoretical, simulation, and experimental analyses of the ion-acoustic instability and its turbulent resistivity. (Diss. Abstr. Int., B)

5227 GENERATION OF VORTEX RINGS IN A CONICAL THETA PINCH. Spiegel, M. S. Coral Gables, FL; Univ. of Miami (1974). 150p. University Microfilms Order No. 75-12,868.

Thesis (Ph. D.).

The formation process of magnetohydrodynamic vortex rings in a conical theta pinch is investigated. Magnetic probes, high speed photography, and relative spectral intensities are used to follow the space-time development of the vortex structure as it is ejected from the conical coil. Rings created by the second half cycle were found to have the maximum axial and azimuthal magnetic fields. Measurement of these fields indicate the compressed plasma column does not divide about the midplane of the coil as had been thought. Side on and end on high speed photographs indicate the rings are formed at the mouth of the cone. Side on streak pictures substantiate the major role of Hall currents in the formation of vortex rings. A modification of previous theory is made which accounts for the experimental findings of this work. (Diss. Abstr. Int., B)

5228 NUMERICAL SOLUTIONS OF NONLINEAR PLASMA EQUATIONS BY THE FINITE-ELEMENT METHOD. Ezzuddin, Z. Y. Los Angeles; Univ. of California (1975). 134p. University Microfilms Order No. 75-17,783.

Thesis (Ph. D.).

Numerical solution of the nonlinear Vlasov's equation for a collisionless plasma by means of the finite-element Galerkin approximation is considered. An algorithm suitable for numerical calculations is proposed and explicit error estimates are given. Using these estimates, it is shown that the approximate solutions generated by the proposed algorithm converge to the true solution. Also the rate of convergence for the finite-element Galerkin approximation of the nonlinear Vlasov-Poisson equations is established. To gain some computational experience with the proposed algorithm, numerical experiments are performed for the case of a one-dimensional electron-ion plasma. (Diss. Abstr. Int., B)

5229 CHARGE-EXCHANGE SPECTRA NEAR THE INJECTION ENERGY IN TOKAMAKS EQUIPPED WITH TANGENTIAL NEUTRAL BEAMS. Goldston, R. J. (Princeton Univ., NJ). Nucl. Fusion; 15: No. 4, 651-655(Aug 1975).

A relatively simple theory is developed to predict the energy spectrum of charge-exchange neutrals emitted from a tokamak at energies near that of a tangentially injecting neutral beam. The theory is based on a solution to the Fokker–Planck equation which is valid near the injection energy and angle. It is compared with detailed charge-exchange measurements of ion bunches slowing down in the ATC plasma, with steady-state spectrum measurements, and with rise-time measurements of the spectrum near the injection energy after the beam is turned on. Each of these is a test of the classical nature of the slowing-down process, and each gives excellent agreement with theory. On the basis of these results, the theory is used to show how a collimated neutral-beam probe combined with a multi-sight-line detector can be used to measure radial profiles of background neutral density, and of Z/ sub eff/. (auth)

5230 INFLUENCE OF PERTURBING MAGNETIC FIELDS ON HIGH-BETA PLASMA COLUMNS. Kiyama, S. (Electrical Lab., Tokyo); Newton, A. A.; Wootton, A. J. Nucl. Fusion; 15: No. 4, 563-571(Aug 1975).

Experiments on the motion of a deuterium plasma in a theta pinch and a screw pinch in the presence of local perturbing magnetic fields are described. Small coils outside the vacuum vessel were used to superimpose a dipole field on the theta pinch, and a transverse field on the screw pinch, and measurements were made of the resulting plasma motion. Experiments were performed using a 350-cm long theta-pinch coil which produced plasmas with an average beta up to 0.45 and an average temperature up to 65 eV. Perturbing fields of ~5% of the main axial field of 17.5 kG produced local displacements of ~1 cm, which propagated along the plasma with a velocity of about 20 cm μs^{-1}. The displacement was proportional to the perturbing field, and was spatially damped with an e-folding length of about 20 cm. Screw-pinch experiments were performed by superimposing an axial current of 10 kA on the theta pinch; this produced instability growth rates of about 0.5×10^6 s^{-1}. A transverse field of ~2 kG excited plasma displacements of ~1 cm. This displacement was found to be proportional to both the axial plasma current and the perturbing field. In all cases the plasma column remained intact and no additional instabilities or rapid diffusion were observed. Predictions of plasma displacement were made using a simple model and good agreement with the experimental results was obtained. (auth)

5231 POSSIBLE CAUSE OF ELECTRON BEAM PINCHES NEAR A TARGET. Linhart, J. G. Nucl. Fusion; 15: No. 4, 707-710(Aug 1975).

An earlier suggestion that a "super-pinch" might develop on an intense electron beam as a result of passage through some discontinuity such as a conducting target is discussed. A single particle analogy of an electron-positron collision is used. The analysis is then extended to relativistic electron beams. (MOW)

Plasma Production

Refer also to abstract 5443.

5232 CONTROL OF ION-ENERGY DISTRIBUTION IN A BACK-DIFFUSION TYPE PLASMA. Kawai, Y. (Kyushu Univ., Fukuoka). Rep. Res. Inst. Appl. Mech. (Kyushu Univ.); 22: 147-153(Mar 1975).

Experimental study was made of control of ion-energy distribution in a back-diffusion-type plasma by the funnel-type plasma source. It was shown that both the ion beam energy and ion temperature in this type of plasma can be controlled easily by changing the grid potential or anode potential of the funnel-type source. This suggests that the funnel-type plasma is more suitable for wave experiments such as wave-particle interactions. (auth)

5233 PLASMAS PRODUCED BY NEUTRAL INJECTION IN THE CULHAM LEVITRON. Alcock, M. W.; Bradford, R. E.; Freeman, R. (EURATOM-UKAEA, Abingdon, Eng.). pp 77-87 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.2); CONF-741105-P2.

The initial experiments with the Culham Superconducting Levitron Experiment are described in which plasmas were produced by fast neutral injection and by Ohmic heating. A ring current of 300 kAT is used; in the early experiments the toroidal field current was restricted to about 40 kAT but in more recent experiments this has been raised to 300 kaT. Using Ohmic heating, plasma densities of up to 5×10^{11} cm^{-3} have been produced which are suitable for use as targets for neutral injection. With the low toroidal field (low shear) the containment time is apparently restricted to $10\text{-}20\tau_{Bohm}$ and a Bohm-like scaling with T_e is necessary to explain the time behavior in the afterglow. With high toroidal field (high shear) and containment time is increased to $60\text{-}100\tau_{Bohm}$. The early experiments with only 125 W of injected neutral beam showed good containment of the hot ions but the beam intensity was insufficient to achieve build-up. Experiments are just commencing on the injection of much larger beam powers but the full beam power now available (2 kW) has not yet been combined with an optimized target plasma. (auth)

5234 SIMPLE AVERAGED SOLUTION OF THE PROBLEM OF ADIABATIC IMPLOSION OF A SPHERICAL LINER. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 23: No. 4, 157-164(1975).

A simplified model for obtaining an averaged solution in quadratures of the problem of concentric adiabatic implosion of a thin spherical liner is presented. The maximum compression is appraised together with the relevant implosion energy. The agreement with some numerical solutions was found to be good as regards the order of magnitude. (auth)

Plasma Stability

Refer also to abstracts 5115, 5159, and 5318.

5235 (COO-3497-13) ANNUAL PROGRESS REPORT. Simon, A. (Rochester Univ., N. Y. (USA)). 19 Sep 1975. Contract E(11-1)-3497. 13p. Dep. NTIS $4.50.

Considerable success has been achieved this year in research aimed at extending the asymptotic threshold nonlinear theory to plasmas governed by the Vlasov equation and in a group of linear studies concerned with drift instabilities in sheared magnetic fields. The nonlinear results are general and have been applied to the bump-on-tail instability and to the collisionless drift and the dissipative trapped electron instability in unsheared fields. The linear studies have dealt with the effects of resonant electrons, finite collisionality, finite-beta, neoclassical modifications and ion gyro-motion on trapped electron instabilities in sheared magnetic fields. (auth)

5236 (LA-UR-75-1558) DYNAMIC MODEL OF GROSS PLASMA MOTION IN SCYLLAC. Miller, G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750944-20). Dep. NTIS $4.00.

From 3rd topical conference on pulsed high beta plasmas; Abingdon, Oxfordshire, UK (9 Sep 1975).

Plasma confinement in a high-beta stellarator such as Scyllac is ended by an unstable long wavelength m equals 1 motion of the plasma to the discharge tube wall. Such behavior has been observed in several experiments and is considered well understood theoretically on the basis of the sharp boundary ideal MHD model. However the standard theoretical approach using the energy principle offers little physical insight, and sheds no light on the process by which the plasma reaches an equilibrium configuration starting from the initial conditions created by the theta pinch implosion. It was the purpose of this work to find a more complete explanation of the observed plasma behavior in Scyllac and to apply this to the design of a feedback stabilized experiment. Some general consideration is also given to dynamic stabilization. (auth)

5237 (LRP–93/75) FEEDBACK STABILIZATION OF A SCREW PINCH. Keller, R.; Pochelon, A.; Bachmann, W. (Ecole Polytechnique Federale, Lausanne, (Switzerland)). Jun 1975. 21p. (In French) Dep. NTIS (US Sales Only) $4.50.

Preliminary results are given of the feedback stabilization of a screw pinch obtained with an amplifier operating at reduced power. (auth)

5238 (LRP-96/75) FEEDBACK STABILIZATION OF A SCREW PINCH. Keller, R.; Pochelon, A.; Bachmann, W. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Oct 1975. 7p. Dep. NTIS (US Sales Only) $4.50.

Results from a stabilization experiment operating on the kink mode of a screw pinch by means of a magnetic feedback loop are presented. (auth)

5239 (MATT-1162) OSCILLATING TWO-STREAM INSTABILITY AT THE RESONANCE OF OBLIQUELY INCIDENT RADIATION IN INHOMOGENEOUS PLASMAS. Kuo, Y. Y.; Oberman, C.; Liu, C. S.; Troyon, F. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Oct 1975. Contract E(11-1)-3073. 26p. Dep. NTIS $4.00.

The growth rate and the threshold value were calculated for the oscillating two-stream instability for an electromagnetic wave obliquely incident on an inhomogeneous plasma. The localization of the instability is found to be in the overdense region near the threshold and to shift toward the local plasma resonance when the pump intensity increases. (auth)

5240 (MATT-1163) RESISTIVE INSTABILITIES IN A TOKAMAK. Glasser, A. H.; Greene, J. M.; Johnson, J. L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Oct 1975. Contract E(11-1)-3073. 30p. Dep. NTIS $5.00.

Application of resistive instability theory shows that toroidal effects can stabilize the tearing mode in devices like the Princeton Large Torus. Contraction of the current channel is destabilizing. Finite fluid compressibility is crucial to this phenomenon. (auth)

5241 (ORNL-TM--5158) RESONANT ELECTRON EFFECTS ON TRAPPED ELECTRON INSTABILITIES. Catto, P. J.; Tsang, K. T.; Callen, J. D.; Tang, W. M. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 14p. Dep. NTIS $4.00.

The importance of retaining resonant electron contributions when considering trapped electron instabilities has recently been noted. The necessity of distinguishing between perpendicular and parallel components in electron velocity space, rather than simply considering energy, is pointed out and employed to estimate the effects of finite collisionality. For much of the banana regime the dominant resonant electron contributions are shown to be due to circulating electrons with parallel velocities in the vicinity of and slightly below the electron thermal speed. (auth)

5242 (ORNL-tr-4029) CALCULATION RESULTS ON DYNAMICS OF HELICAL MHD: INSTABILITY. Gerlach, N. I.; Zueva, N. M. 1973. Translation of preprint No. 91. 9p. Dep. NTIS $4.50.

Dynamics of helical MHD-instability is numerically investigated. A simplified equilibrium cylindrical configuration is chosen, and a small resonance helical initial perturbation is given: the constant pitch value of helical magnetic field lines is the same one as for the initial perturbation. The arising motion is supposed to conserve helical symmetry. An appropriate initial-value problem is solved by means of computer. Patterns of density distribution obtained at different time moments indicate the process of the instability development to be quasi-periodical. AT initial stage of the process, vacuum bubbles are coming into the plasma. Further the surfaces of constant density form a fibrous structure. (auth)

5243 (UCRL-Trans--10935) LAGRANGIAN APPROACH TO THE PROBLEM OF THE HYDRODYNAMIC INSTABILITIES OF A SPHERICAL IMPLOSION. Brun, L.; Sitt, B. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Sep 1975. Translation of French Report DO--133. 22p. Dep. NTIS $4.50.

For the study of hydrodynamic instabilities of a spherical implosion, a very simple Lagrangian-type formulation is proposed, based on the introduction of a potential of transverse displacements, and on the decomposition of disturbances into spherical harmonics. The different modes are decoupled, and can be studied independently. The development of a numerical code utilizing this formulation can then be considered. (auth)

5244 PARAMETRIC INTERACTION OF LASER BEAM WITH INHOMOGENEOUS PLASMAS. Kono, M.; Yajima, N. (Kyushu Univ., Fukuoka). Rep. Res. Inst. Appl. Mech. (Kyushu Univ.); 22: 117-125(Mar 1975).

Parametric instability of electrostatic oscillations in a semi-infinite plasma subjected to electromagnetic radiation is studied. The possibility of the parametric decay of evanescent photon is pointed out. The threshold power of the incident radiation for this process is obtained by using the reductive perturbation method. (auth)

5245 STABILIZING MECHANISMS FOR LOSS-CONE MODES. Baldwin, D. E. (Univ. of California, Livermore); Berk, H. L.; Pearlstein, L. D.; Kammash, T.; Uckan, T. pp 301-310 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

An investigation was made of various mechanisms that might be responsible for the apparent absence of the theoretically predicted drift-cyclotron-loss-cone mode in high-density mirror machines when omega^2/sub pe/ approximately omega^2/sub ce/. Warm plasma outside the trap at 2XII parameters is found to affect the mode only weakly. Fanning of the magnetic field is found to stabilize modes sharply resonant in k/sub perpendicular to/, such as the Dory-Guest-Harris mode, but not to affect instabilities with broad spectra. Also investigated is the possibility of electron orbit diffusion due to the presence of a suggested high-frequency electron instability. Stabilization by this means would explain a number of experimentally observed properties; however, the nonlinear picture is incomplete as discussed. The standard one-dimensional, absolute instability criterion is extended to two dimensions and effects of finite m/sub e//m/sub i/ less than beta much less than 1 are included. At ion energies spanning present experimental conditions to reactor conditions, one finds only a weak shift in the instability threshold densities. (auth)

5246 PLASMA CONTAINMENT IN 2XII. Coensgen, F. H.; Cummins, W. F.; Molvik, A. W.; Nexsen, W. E. Jr.; Simonen, T. C.; Stallard, B. W. (Univ. of California, Livermore). pp 323-328 of Plasma physics and controlled nuclear fusion research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Experiments in the 2XII magnetic mirror device have achieved high-beta (beta approximately 0.3 to 0.5) plasma confinement. Near classical confinement was observed in the range 2 to 5 x 10^{13} cm^{-3} with average ion energies of 1 to 3 keV. The measured electron energy, 50 to 150 eV, was consistent with classical energy transfer from the hot ions. At lower plasma densities, the loss rate departs from classical confinement owing to quasi-classical scattering and ion cyclotron fluctuations. The injection of a 10-A, 20-keV neutral atom beam produced no beam-driven instabilities, nor did it increase charge-exchange losses. (auth)

5247 MHD-INSTABILITIES AS AN INITIAL-WAVE PROBLEM FOR ELONGATED CROSS SECTIONS. Schneider, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.); Bateman, G. pp 429-438 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Internal kink instabilities are studied for straight and toroidal plasma equilibria with elongated cross-section. The instabilities are computed by solving the linearized ideal MHD-equations as an initial boundary-value problem. Cross-sections of the perturbed velocity, B-field and current density are exhibited as well as parameter studies of the growth rate. (auth)

5248 TOROIDAL CALCULATIONS OF TOKAMAK STABILITY. Wesson, J. A.; Sykes, A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 449-461 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

A numerical procedure and a computer code were developed which solve the hydromagnetic stability problem for axisymmetric toroidal plasmas, with and without a surrounding vacuum region. The method is based on a time-dependent solution of a modified form of the linearized equations of motion. The code has been used to investigate two sets of tokamak configurations. The first set are of 3:1 aspect ratio and circular cross-section. The second set are of 2.5:1 aspect ratio and have an elongated cross-section. Stability boundaries, growth rates and eigenfunctions are presented for these cases. It is found that the tight aspect ratio tokamak has beneficial stability properties. (auth)

5249 STUDY OF MAGNETOHYDRODYNAMIC MODES IN TOKAMAK CONFIGURATIONS WITH NONCIRCULAR CROSS-SECTIONS. Chance, M. S.; Dewar, R. L.; Glasser, A. H. (Princeton Univ., NJ). Contract AT(11-1)-3073. pp 463-473

of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Stability criteria for localized instabilities for both ideal and resistive models are derived and evaluated for general axisymmetric configurations. A numerical scheme for determining the spectrum in these configurations is developed. Application is made to the special case of an elliptical cylindrical plasma column, with finite pressure and length, carrying a uniform axial current. (auth)

5250 KINK INSTABILITIES FOR SHAPED TOKAMAKS IN TOROIDAL GEOMETRY. Kerner, W.; Tasso, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 475-484 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

The Hill vortex solution is used to produce axisymmetric equilibria (e.g. tokamak) with ellipse-like cross-sections and poloidal currents, the toroidal current being roughly constant over the cross-section. The plasma is surrounded by a vacuum and a perfectly conducting wall. The stability investigation for this plasma vacuum system is done by using the energy principle. Appropriate curvilinear coordinates are explicitly introduced and allow analytic integration with respect to the angles the long and the short way around the torus. The energy integral is evaluated with test functions similar to the eigenfunctions of the corresponding cylindrical plasmas. The very large algebraic expressions were handled by symbolic computation techniques (REDUCE). This leads to exact results on kink instabilities for circular and shaped cross-sections in toroidal geometry and for several values of β_{pol}. It is easier to find the instabilities for the elliptical cross-section than for the circular cross-section. There exist instabilities above and below the Kruskal-Shafranov limit. The test functions are not good enough to allow a decision on stability for aspect ratios smaller than ≈ 5. (auth)

5251 NUMERICAL STUDIES OF NONLINEAR EVOLUTION OF KINK AND TEARING MODES IN TOKAMAKS. White, R. (Inst. for Advanced Study, Princeton, NJ); Monticello, D.; Rosenbluth, M. N.; Strauss, H.; Kadomtsev, B. B. Contract AT(11-1)-3237; AT(11-1)-3073. pp 495-503 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

A set of numerical techniques for investigating the full nonlinear unstable behavior of low-beta kink modes of given helical symmetry in tokamaks is presented. Uniform current density plasmas display complicated deformations including the formation of large vacuum bubbles, provided that the safety factor q is sufficiently close to integral. Fairly large m equals 1 deformations, but not bubble formation, persist for a plasma with a parabolic current density profile (and hence shear). Deformations for m greater than or equal to 2 are however greatly suppressed. (auth)

5252 STABILITY OF KINK MODES IN HIGH-BETA TOKAMAKS. Freidberg, J. P.; Goedbloed, J. P.; Grossmann, W.; Haas, F. A. (Los Alamos Scientific Lab., NM). pp 505-514 of Plasma physics and controlled nuclear fusion research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

MHD stability calculations of high-beta approximately a/R tokamak configurations are given for three separate classes of equilibria: (1) the thin-skin sharp-boundary model, (2) the quasi-uniform-current model, and (3) the diffuse-profile model. (auth)

5253 TRANSPORT IN LARGE TOKAMAKS INDUCED BY TRAPPED-PARTICLE INSTABILITIES. Green, B. J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.); Pfirsch, D.; Saison, R.; Wimmel, H. K.; Marty, D. pp 517-530 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Under plasma conditions aimed for in the next generation of tokamak devices, trapped-particle effects should be clearly observable. In particular, trapped-particle instabilities of different types are predicted to lead to large energy loss rates which would severely limit the temperatures and containment times attainable. The scaling of these effects is examined and related to the appropriate design of future devices to achieve certain conditions, and to the prediction of parameters attained with a given machine. One of the trapped-ion instabilities viz, the dissipative trapped-ion mode, is examined to see how effective certain stabilizing mechanisms are. For this model it appears that there is great sensitivity to the radial profiles of plasma density and temperature. Ion collisional damping increases through the presence of impurities, but depends critically on the distribution of impurities and, for significant stabilization, seems to require concentrations which would be energetically undesirable because of large radiative losses. A full global energy balance is carried out for a prototype tokamak reactor design and it is shown that even in the presence of the trapped-ion instability, and with reasonable additional heating power, a net energy gain is possible. (auth)

5254 STABILITY THEORY OF DISSIPATIVE TRAPPED-ELECTRON AND TRAPPED-ION MODES. Horton, W. Jr. (Univ. of Texas, Austin); Ross, D. W.; Tang, W. M. Contract AT(11-1)-3073; AT(40-1)-4478. pp 541-548 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

This paper treats topics in the linear theory of dissipative trapped-electron instabilities, and in the nonlinear theory of the dissipative trapped-ion instabilities. Stability criteria are obtained for dissipative trapped-electron modes in a tokamak-type magnetic field with shear. In the important case where the mode is driven by the electron temperature gradient, and neglecting "ballooning" effects, shear is found to stabilize the mode if typically r/sub n// L/sub s/ greater than 0.1 (r/2R)/sup 1/2/ dln T/sub e//dln n, a condition that can be attained. With weak shear, it is shown, however, that the mode-structure along the field can exhibit substantial "ballooning". The dissipative trapped-ion mode, which is not shear-stabilized, is considered in its nonlinear regime. Including nonlinear E x B motions, exact stationary trapped-ion-mode solitary-wave solutions are found, in which the wave energy in longer azimuthal wavelengths passes to shorter-wavelength components that are strongly damped by ion bounce resonances; the amplitudes are sufficiently reduced that a diffusion lower than Kadomtsev's is indicated. As a second nonlinear mechanism, anomalous velocity-space scattering due to the development of an unstable loss-cone-type ion distribution function is considered; this mechanism raises the effective ion collision frequency and increases the stability of the longer-azimuthal-wavelength modes. (auth)

5255 PARAMETRIC INSTABILITIES IN INHOMOGENEOUS, SPHERICAL PLASMAS. Liu, C. S.; Rosenbluth, M. N.; White, R. B. (Inst. for Advanced Study, Princeton, NJ). pp 515-524 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Temporally growing instabilities for Raman and Brillouin sidescattering are found to persist in an inhomogeneous, expanding spherical plasma with nonuniform expansion velocity. Their growth rates and thresholds are modified by the spherical geometry because of the wave refraction. (auth)

5256 HIGH-DENSITY FUSION AND Z-PINCH. Hartman, C. W.; Cheng, D. Y.; Cooper, G. E.; Eddleman, J. L.; Munger, R. H. (Univ. of California, Livermore). pp 653-661 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

The formation of a Z-pinch in dense gas is investigated using numerical modeling in one and two dimensions. Hot, dense Z-pinches are calculated with n approximately 2×10^{21} cm^3 and T equals 10 keV. Relaxation by sausage instability of an unstable pinch profile to a marginally stable one is calculated along with end losses in 2 dimensions to show that, if plasma is confined for N equals 50 to 200 sound transits across the radius a, pinches with length L equals Na are of interest for fusion power. A conceptual, "no-wall" fusion reactor is discussed. (auth)

5257 EFFECTS OF GRADIENTS ON ELECTROSTATIC INSTABILITIES IN COLLISIONLESS SHOCKS. Bharuthram, R.; Hellberg, M. A. (Univ. of Natal, Durban, South Africa). pp

693-703 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.2); CONF-741105-P2.

Calculations are presented on the role of weak gradients in density, perpendicular electron temperature and magnetic field on the crossfield current-driven ion acoustic instability and the electron cyclotron drift instability (ECDI) in a plasma with cold ions. For the former, it is found that ∇T is destabilizing only for $k_\perp \rho_e \gtrsim 1$. For the latter instability, growth rates are deduced for two cases: (1) perpendicular propagation with $k_\perp \rho_e$ unrestricted, and (2) $k_z \neq 0$, but in a restricted regime, with $k_\perp \rho_e \gg 1$. In each case a resonant value of $k_\perp \rho_e$ is assumed. The oblique propagation case refers to the transition regime in which the ECDI goes over into the ion acoustic instability, and the temperature gradient is again found to be destabilizing. (auth)

5258 NUMERICAL STUDY OF THE MAGNETOHYDRODYNAMIC SPECTRA IN TOKAMAKS USING GALERKIN'S METHOD. Dewar, R. L.; Greene, J. M.; Grimm, R. C.; Johnson, J. L. (Princeton Univ., NJ). J. Comput. Phys.; 18: No. 2, 132-153(Jun 1975).

A computational technique is described for determining the ideal magnetohydrodynamic spectrum and its associated eigenfunctions. The method is suitable for axisymmetric toroidally confined plasmas with arbitrary cross sections. Using the special case of a long, straight, elliptical plasma column with low pressure and uniform axial current where analytic results are available, a study is made of the efficacy of two different choices of expansion functions. The use of a finite-element representation, keeping only a small number of terms, is shown to provide a good description of the system. (auth)

5259 LINEAR INSTABILITIES IN THE QUASISTATIC GUIDING-CENTER PLASMA. Shoucri, M. M. Iowa City, IA; Univ. of Iowa (1974). 197p. University Microfilms Order No. 75-13,821.

Thesis (Ph.D.).

A numerical scheme is developed to study the stability of the linearized three-dimensional guiding-center equations of a plasma of cold ions and hot electrons. The linear growth rates of the Kelvin-Helmholtz instabilities resulting from a velocity shear introduced by a non-uniform E Vector x B Vector drift are calculated numerically under the following assumptions: (a) The oscillations are quasistatic Nabla Vector x E Vector approximately 0. (b) The magnetic field B Vector equals Be/sub z/ is constant in space, direction, and time, and points in the z direction. (c) The plasma is non-neutral and the unperturbed electric field and density gradients are in the direction of the x axis and are functions of x only. (d) The unperturbed drift velocity approximately E Vector x B Vector is the y direction. In particular, the theory of neutrally stable waves in two dimensions is verified for a velocity profile of the form of a sine function, and the instability growth rates of the oscillations in the neighborhood of the neutrally stable waves are calculated numerically and are shown to be in very good agreement with theory. The effect of large wavelength oscillations along the magnetic field on these instabilities is studied. The numerical scheme is also used to study the linear instabilities of the density drift waves in an inhomogeneous neutral plasma. Finally, some analytical results are derived for the linear instabilities of a cylindrical plasma column in the guiding-center approximation. (Diss. Abstr. Int., B)

5260 IMPROVED CALCULATION OF CRITICAL MAGNETIC SHEAR IN AN INHOMOGENEOUS PLASMA. Rosenbluth, M. N. (Inst. for Advanced Study, Princeton, NJ); Catto, P. J. Nucl. Fusion; 15: No. 4, 573-582(Aug 1975).

Previous calculations of the amount of magnetic shear necessary to stabilize a drift wave in an inhomogeneous plasma with a linear density profile have been somewhat inconsistent in that the destabilizing influence of the resonant electrons is treated as a perturbation. By removing this inconsistency and, in fact, by including all non-resonant electron effects as well, an improved stability criterion is found analytically to agree with the previous perturbation technique result to within a multiplicative factor very nearly equal to one for 1 greater than or equal to L/sub n//L/sub s/ much greater than m/M, where L/sub n/ and L/sub s/ are the density and shear lengths and m and M are the electron and ion masses. Both the previous and the present treatments require ln (ML/sub n//mL/sub s/) greater than 1, and the stability condition is found herein to be relaxed by approximately [ln[ln(ML/sub n//mL/sub s/)]]/sup 1/3/. Furthermore, the critical shear is shown to be relatively insensitive to the non-resonant electron corrections not retained in previous work. Consequently, when finite-beta effects are included, both the neglect of non-resonant electron corrections to the fluid response and the treatment of the resonant electrons via perturbation theory are well motivated. (auth)

5261 SELF-CONSISTENT PLASMA AND ENGINEERING PARAMETERS FOR SELF-SUSTAINING (IGNITED) TOKAMAK POWER REACTORS. Stacey, W. M. Jr. (Argonne National Lab., IL). Nucl. Fusion; 15: No. 4, 583-593(Aug 1975).

Self-consistent calculations of the plasma energy and particle balances, the plasma current required for confinement according to trapped-ion instability theory, the toroidal magnetic field required for MHD-stability, the transformer magnetic field required to create and maintain the plasma current, and the maximum power allowed by either MHD-stability or neutron power flux to the first-wall limits are reported. If q approximately 1 and beta/sub THETA/ approximately root A can be achieved and if plasma contamination can be held to Z/sub eff/ approximately 1.3, then reactors with a wide range of geometries (R equals 7.5 - 15.0 m, A equals 3-5) with power outputs of 1-10 GW and burn times of the order of hours are feasible with realistic technological constraints--maximum toroidal fields at the coils less than 80 kG and maximum neutron power fluxes on the first wall less than 2.0 MW/m^2. The consequences of operation under different plasma MHD-stability and technological constraints are also examined. (auth)

5262 STABILITY OF A CLOSED-LINE SCYLLAC CONFIGURATION. Freidberg, J. P.; Gerwin, R. A. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 15: No. 4, 605-610(Aug 1975).

A stability analysis against m equals 1 modes is presented for a closed-line Scyllac configuration. The configuration consists basically of a large THETA-pinch field and moderate-size l equals +1 and l equals -1 fields with exactly equal amplitudes. It was originally hoped that the l equals +-1 system would have more favorable stability properties than the pure l equals 1 Scyllac configuration. The calculations show that this is not the case, and that, indeed, the l equals +-1 system is far more unstable. (auth)

5263 FREQUENCY-DEPENDENT FEEDBACK CONTROL OF PLASMA INSTABILITIES. Uckan, N. A.; Kammash, T. (Univ. of Michigan, Ann Arbor). Nucl. Fusion; 15: No. 4, 611-619(Aug 1975).

A general theory of simultaneous feedback stabilization of multimode oscillations in collisionless magnetized plasma is developed for reactive and dissipative instabilities. The gain and phase requirements of the feedback circuit are obtained using familiar stabilization techniques. From causality and stability considerations further requirements on phase and gain are determined for a physically realizable feedback system. It is shown that unstable modes can be suppressed without driving new instabilities or causing stable modes to become unstable. Although this method of stabilization provides marginal stability for instabilities of the reactive type by correctly choosing the frequency dependence of the feedback gain, this problem can be overcome, and the stability properties of the feedback loop can be improved. Applications to some known reactive instabilities are included as examples. (auth)

5264 CONTINUOUS MHD SPECTRUM IN TOROIDAL GEOMETRIES. Pao, Y. P. (New York Univ., NY). Nucl. Fusion; 15: No. 4, 631-635(Aug 1975).

The continuous spectrum for tokamak geometries is shown to be given by a reduced (one-dimensional nonsingular) eigenvalue problem on the resonant surface. Properties of this reduced eigenvalue problem and singularity of the eigenfunctions for the continuous spectrum near the resonant surface are obtained. (auth)

5265 BEHAVIOUR OF TOKAMAK PLASMA IN THE DYNAMIC LIMITER EXPERIMENT. Toi, K.; Takeda, T.; Suzuki, N.; Sugawara, T.; Itoh, S.; Shirakata, H.; Takahashi, K.; Yano, S. (Japan Atomic Energy Research Inst., Tokai). Nucl. Fusion; 15: No. 4, 637-642(Aug 1975).

A description of an experiment with a dynamic limiter—a pneumatically driven limiter of the JAERI tokamak, JFT-2—is presented. Plasma behavior is studied for the case of the dynamic limiter being quickly retracted during the discharge; this is done to clarify the role a material limiter plays in equilibrium and stability of a tokamak plasma. It has been seen from the response of a plasma ring to the high-frequency (≈1 kHz) electric field superimposed on the main electric field that the edge of the hot-plasma region, with effective radius a and a conductivity electron temperature of 20 to 100 eV, expands together with the dynamic limiter; this fact has been confirmed by the time behavior of the plasma boundary as derived from the time variation of the light intensity. The ion temperature (T_i), which is obtained by the charge-exchanged neutral-particle energy analyser, obviously decreases after retraction of the limiter. Moreover, it is shown that, in this phase, $a^5 T_i$ is almost constant. This behavior ($a^5 T_i \approx$ const.) is shown to be due to the fact that, by neoclassical trans-

port theory, $\lambda N_e^{\frac{1}{2}}$ is almost independent of time, where λ is the proportionality coefficient of Artsimovich's ion temperature scaling law and N_e is the total number of electrons. (auth)

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Refer also to abstracts 5091, 5207, 5243, 5280, 5405, 5409, 5420, 5422, 5442, 5447, 5470, 5959, 6041, and 6050.

5266 (ANL/HEP-CP-66) SUPERCONDUCTING OHMIC-HEATING COILS FOR THE ARGONNE TEPR DESIGN STUDY. Turner, L. R.; Wang, S. T.; Purcell, J. R. (Argonne National Lab., Ill. (USA)). 1975. 5p. (CONF-751125-13). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A system of air-core superconducting ohmic-heating coils was studied for the Argonne TEPR design. The OH coil requirements, the basis for the choice, and a suitable conductor are described. A 3.6 m diameter, 13 m long solenoid plus ten other coils with diameters up to 23 m provide (together with the equilibrium coils) the needed 110 volt-sec flux change while producing little magnetic field at the plasma region or at the toroidal field coils. (auth)

5267 (ANL-Trans--993) DAMAGE TO MATERIALS DURING IRRADIATION WITH A PARTICLE CURRENT WITH A WIDE ENERGY SPECTRUM. Gusev, V. M.; Guseva, M. I.; Krasulin, Yu. L.; Martinenko, Yu. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation of IAE--2529. 14p. Dep. NTIS $4.50.

Blistering under the effects of accelerated He ions depends substantially on the distribution according to depth (profile) of interstitial ions and defects created with ion irradiation. In this work, profiles are calculated for interstitial ions and defects for the ion energy spectrum expected in thermonuclear reactors operating with a D-T-reaction. Recommendations are made for experimental modeling of the effects of ions with a wide spectrum of energies at the target. (auth)

5268 (BNL-20531) ANALYSIS OF RADIATION DAMAGE IN FUSION-SIMULATION NEUTRON SPECTRA. Parkin, D. M.; Goland, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 20p. (CONF-751026-21). Dep. NTIS $4.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Various parameters which are relevant to an understanding of radiation effects in metals have been evaluated utilizing available neutron spectrum information for several existing sources, e.g., EBRII, HFIR, and LAMPF, as well as the hypothetical spectrum at a fusion reactor first wall, and measured Li(d,n) spectra. Recoil energy distributions were calculated for several metals including Al, Cu, and Nb. The recoil energy range was divided into groups, and the fraction of recoils occurring in each energy group was compared with the fraction of the damage energy contributed by that group. From this comparison it was possible to conclude that the significant recoil range differs by about an order of magnitude between fission and fusion sources. The analysis further confirms that basic defect production characteristics depend upon the neutron spectrum, and that integral calculations of radiation-effect parameters do not provide a complete description of the dependence. This is equally true for comparisons between fusion-related spectra or fission-reactor spectra independently. Four recoil-dependent parameter functions which describe different aspects of radiation damage were used in the calculations. The relative effectiveness of neutron sources was found to depend upon the choice of parameter function. Fission-reactor spectra comparisons are relatively insensitive to the parameter functions used whereas spectra with an appreciable component of high-energy neutrons are much more sensitive. (auth)

5269 (BNL-20563) TRITIUM RECOVERY FROM FUSION BLANKETS USING SOLID LITHIUM COMPOUNDS. Powell, J. R.; Wiswall, R. H.; Wirsing, E. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1975. 50p. Dep. NTIS $5.45.

Separate abstracts were prepared for the two included papers. (MOW)

For abstracts of individual papers see: 5270 and 5271.

5270 (BNL-20563, pp 1-28) TRITIUM RECOVERY FROM FUSION BLANKETS USING SOLID LITHIUM COMPOUNDS. I. Design and Minimization of Tritium Inventory. Powell, J. R. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1975.

In tritium recovery from fusion blankets using solid lithium compounds.

Tritium blanket inventories of 100 curies/MW(e) are readily achievable, and inventories as low as 10 curies/MW(e) are possible for blankets with small lithium compound particulates (less than or equal to 50 mu) at T greater than or equal to 800°C. Of the three release modes [A - to the main coolant (e.g., He) stream; B - to a separate processing circuit; and C - to the plasma region], mode A appears optimum for blankets using gas-cooled metallic structures (e.g., Al, stainless), while mode C appears optimum for high temperature refractory (e.g., C, SiC) structures. The greater structural complexity of mode B makes it less attractive than modes A and C. No recovery method is required for mode C release. With mode A release, tritium inventory in the coolant circuits ranges from 1 to 10 curies/MW(e), depending on processing parameters. Tritium leak rates to the environment during normal operation can be kept to less than or equal to 10^{-3} curies/MW(e) per day with low permeability barriers. In general, a mixture of T_2 and T_2O is present in the coolant stream. Three methods of tritium recovery are examined: (1) Conversion to T_2 followed by absorption in a metal hydride bed. (2) Conversion to T_2 followed by condensation at approximately 6°K. (3) Conversion to T_2O followed by condensation at approximately 100°K. (auth)

5271 (BNL-20563, pp 29-40) TRITIUM RECOVERY FROM FUSION BLANKETS USING SOLID LITHIUM COMPOUNDS. II. Experiments on Tritium Removal and Absorption. Wiswall, R. H.; Wirsing, E. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1975.

In tritium recovery from fusion blankets using solid lithium compounds.

It was shown experimentally that tritium can be easily removed from certain solid lithium compounds that have been proposed as components of CTR breeder blankets. The compounds tested were LiAl, Li_7Pb_2, $LiAlO_2$ and Li_2SiO_3 in granular or powder form; the procedure was to pass a stream of helium through a bed of material maintained at a temperature in the range 400-600°C. As the tritium, which had been previously generated in the materials by exposure to thermal neutrons, diffused out and was carried away, its concentration was continuously monitored by radioactive assay of the gas stream. From the data, it was possible to calculate average lifetimes of tritium in a continuously extracted breeder blanket. Lifetimes of a few hours were found for LiAl and Li_7Pb_2 at 400-500°, $LiAlO_2$ at 600° and Li_2SiO_3 at 500-600°. The extraction kinetics of $LiAlO_2$ were consistent with a diffusion-controlled process, and it was possible to calculate diffusion coefficients from the data. A series of hydride-forming metals were tested for their ability to trap out tritium from dilute helium streams and later release it on heating. Vanadium appears to be satisfactory. (auth)

5272 (BNWL-SA-5376) KINETIC STABILITY AGAINST VOID COARSENING IN MOLYBDENUM. Simonen, E. P.; Brimhall, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 15p. (CONF-751026-27). Dep. NTIS $4.50.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

The measured rate of increase of void size in molybdenum with annealing time is found to be slower than expected from the Wagner analysis of diffusion-controlled coarsening. The Wagner theory of surface-reaction-control is also compared with ripening data. The determined surface kinetic parameters are compared with vacancy diffusivities and are found to be not unrealistic. Furthermore, a measured decrease in void volume during annealing indicates that total void volume is not conserved. These observations support the conclusion that void coarsening is influenced by more than one rate controlling mechanism. A numerical solution to the void annealing problem is obtained and the specific role of volume diffusion, surface kinetics, and annealing of vacancies to sinks other than voids is calculated. (auth)

5273 (BNWL-SA-5398) EFFECT OF THE FREE SURFACE ON VOID FORMATION IN ION BOMBARDED MOLYBDENUM. Bradley, E. R.; Brimhall, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 19p. (CONF-751026-28). Dep. NTIS $4.00.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Heavy ion bombardment is currently being considered as a technique to simulate neutron damage in CTR components, especially the first wall structure. The use of heavy ion bombardment as a neutron simulation technique has been criticized due to the damage zone being near a free surface (i.e., less than or equal to 1 micron for 5 MeV Ni^{++} ions in molybdenum). The purpose of the

present investigation was to examine the microstructure of ion bombarded molybdenum at and below the bombarded surface utilizing transmission electron microscopy to determine the influence of the free surface on void formation. Single crystal molybdenum discs were bombarded at 1000° +- 25°C with 5 MeV Ni^{+2} ions at surface dose rates of 3×10^{-4}, 1.8×10^{-3}, and 8×10^{-3} dpa/sec. The void size and density were determined as a function of depth below the bombarded surfaces. Voids were observed within 100 A of the bombarded surfaces and no significant indications of surface-related effects were observed. The variations in void size and density are discussed in terms of the total dose and dose rate at the various regions of examination and the results compared with existing ion bombardment and neutron irradiation data. (auth)

5274 (BNWL-SA-5400) ION BOMBARDMENT SIMULATION: A REVIEW RELATED TO FUSION RADIATION DAMAGE. Brimhall, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 22p. (CONF-751026-29). Dep. NTIS $4.50.

From International conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Prime emphasis is given to reviewing the ion bombardment data on the refractory metals molybdenum, niobium and vanadium which have been proposed for use in advanced fusion devices. The temperature and dose dependence of the void parameters are correlated among these metals. The effect of helium and hydrogen gas on the void parameters is also included. The similarities and differences of the response of these materials to high dose, high temperature radiation damage are evaluated. Comparisons are made with results obtained from stainless steel and nickel base alloys. The ion bombardment data are then compared and correlated, as far as possible, with existing neutron data on the refractory metals. The theoretically calculated damage state produced by neutrons and ions is also briefly discussed and compared to experimental data wherever possible. The advantages and limitations of ion simulation in relation to fusion radiation damage are finally summarized. (auth)

5275 (BNWL-SA--5415) DEFINITION OF SOURCE TERMS FOR TRITIUM EVOLUTION FROM CTR SYSTEMS. Kabele, T. J.; Johnson, A. B.; Mudge, L. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 20p. (CONF-751026--26). Dep. NTIS $4.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

The tritium source terms for several fusion power reactor reference designs are discussed. These reference or conceptual designs have been analyzed to determine, where possible, the amounts and locations of tritium sources within the plants, and the pathways for tritium escape to the environment. (MOW)

5276 (BNWL-SA-5481) ANALYSIS OF TRITIUM RELEASES TO THE ATMOSPHERE BY A CTR. Renne, D. S.; Sandusky, W. F.; Dana, M. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-1830. 52p. (CONF-750967-18). Dep. NTIS $5.50.

From 3rd ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

Removal by atmospheric processes of routinely and accidentally released tritium from a controlled thermonuclear reactor (CTR) was investigated. Based on previous studies, the assumed form of the tritium for this analysis was HTO or tritiated water vapor. Assuming a CTR operation in Morris, Illinois, surface water and ground-level air concentration values of tritium were computed for three space (or time) scales: local (50 Km of a plant), regional (up to 1000 Km of the plant), and global. (auth)

5277 (CLM-R-148) CULHAM STUDY GROUP REPORT ON FUSION REACTORS AND THE ENVIRONMENT. Carruthers, R.; Dunster, H. J.; Smith, R. D.; Watson, C. J. H.; Mitchell, J. T. D. (UKAEA Research Group, Abingdon. Culham Lab.). Jun 1975. 18p. Dep. NTIS (US Sales Only) $4.50. UK £1.00.

The Study Group has established in outline the major determinants of fusion reactor safety. To establish whether and how the requirements can be met (and the cost of meeting them) is not possible without more information. Continuing re-appraisals of fusion reactor safety must be an integral part of fusion design to ensure that the necessary safety measures are incorporated as the design proceeds. The recommendations of the Study Group are given. (MOW)

5278 (CONF-750905--21) SURFACE EROSION OF FUSION REACTOR COMPONENTS DUE TO RADIATION BLISTERING AND NEUTRON SPUTTERING. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 5p. Dep. NTIS $4.00.

From seventh European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Radiation blistering and neutron sputtering can lead to the surface erosion of fusion reactor components exposed to plasma radiations. Recent studies of methods to reduce the surface erosion caused by these processes are discussed. (auth)

5279 (CONF-751026-14) CHEMICAL EQUILIBRIUM STUDIES OF TRITIUM–LITHIUM AND TRITIUM–LITHIUM ALLOY SYSTEMS. Smith, F. J.; Land, J. F.; Talbot, J. B.; Bell, J. T. (Oak Ridge National Lab., Tenn. (USA)). 1975. 16p. Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

In deuterium-tritium fusion reactors currently under design, the production of tritium is accomplished by utilizing a lithium-bearing blanket. Lithium metal is presently the leading candidate for the blanket material, although molten Li_2BeF_4, solid Li–Al (50–50 at. percent) alloy and other lithium-containing materials are distinct possibilities. This paper summarizes progress of ongoing studies of the thermodynamics of some of these lithium containing systems. The individual solubilities of hydrogen, deuterium, and tritium in lithium as a function of temperature (700 to 1000°C) and pressure are presented. Recent work with the solid alloy Li–Al (50–50 at. percent) has shown that the tritium solubility between 400 and 600°C is low. When the tritium pressure was between 0.14 and 0.52 torr, the Li–Al samples contained only 1 to 4 ppm tritium. (auth)

5280 (CONF-751026-15) TRITIUM PERMEATION THROUGH STEAM GENERATOR MATERIALS. Bell, J. T.; Strehlow, R. A.; Redman, J. D.; Smith, F. J. (Oak Ridge National Lab., Tenn. (USA)). 1975. 11p. Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

A model is developed for hydrogen isotope permeation through metals that have one side coated with a material through which the transport of hydrogen is directly dependent on the pressure of hydrogen. (MOW)

5281 (CONF-751039-1) GAS BUBBLES IN STRESS AND THERMAL GRADIENTS. Hall, B. O.; Wiedersich, H. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 23p. Dep. NTIS $4.25.

From international conference on radiation effects and tritium technology for fusion reactors; Oak Ridge, Tennessee, USA (1 Oct 1975).

Inert gases introduced into the first wall of a CTR by injection from the plasma and by (n,alpha) reactions occurring in the wall tend to precipitate into bubbles. The forces on gas bubbles that arise from various sources of stress have been explored. The bubble is approximated by a center of dilatation in an elastically isotropic solid. The first-order size interactions of bubbles with elastic fields due to the presence of the surface, dislocations, other gas bubbles, and thermal gradients have been evaluated. The relative magnitudes of the resultant driving forces on the bubbles have been calculated, and their effect on bubble diffusion is discussed. The region of validity of the center of dilatation approximation has been examined. The effects due to a finite bubble size are described. (auth)

5282 (CONF-751125-35) TOKAMAK EXPERIMENTAL POWER REACTOR. Stacey, W. M. Jr.; Maroni, V. A.; Purcell, J. R. (Argonne National Lab., Ill. (USA)). 1975. 7p. Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A summary is given of a conceptual design study of a Tokamak Experimental Power Reactor (TEPR). Some features of the TEPR are outlined. (MOW)

5283 (CONF-751125-44) OPTIMIZATION OF THE ECT BACKGROUND COIL. Ballou, J. K.; Luton, J. N. (Oak Ridge National Lab., Tenn. (USA)). 1975. 5p. Dep. NTIS $4.00.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This study was begun to optimize the Eccentric Coil Test (ECT) background coil. In the course of this work a general optimization code was obtained, tested, and applied to the ECT problem. So far this code has proven to be very satisfactory. The results obtained with this code and earlier codes have illustrated the parametric behavior of such a coil system and that the optimum for this type system is broad. This study also shows that a background coil

with a winding current density of less than 3000 A/cm^2 is not feasible for the ECT models presented in this paper. (auth)

5284 (DP-MS--75-43) RADIATION DAMAGE BY ^{252}Cf FISSION FRAGMENTS AND ALPHA PARTICLES. Gould, T. H. Jr.; McDonnell, W. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 20p. (CONF-751026--18). Dep. NTIS $4.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Rates of atom displacement and helium injection in materials exposed to ^{252}Cf fission fragments and alpha particles were calculated to establish the potential for use of ^{252}Cf sources for radiation damage studies. Maximum displacement rates of about 10^{-6} dpa/sec at the surface of typical targets exposed to a ^{252}Cf fission fragment source were comparable to those experienced by materials in a fast breeder reactor or in a controlled thermonuclear reactor (CTR) first wall, though much lower than the displacement rates achieved using particle accelerators. Helium was concurrently accumulated at a rate of 3 x 10^{-4} atom ppM/sec at the target surface, yielding a He/displacement ratio 10^3 times that produced in the fast breeder reactor materials, but only about 20 times that produced in the CTR materials. These comparisons suggest that ^{252}Cf fission fragment sources may find useful applications in studies of effects of high-He content on radiation damage in CTR materials. (auth)

5285 (EUR-CEA-FC-769) GENESIS OF TOROIDAL DISCHARGES. Papoular, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Apr 1975. 33p. Dep. NTIS (US Sales Only) $5.00.

This is an analysis of breakdown and ionization of the filling gas of toroidal devices. A model is set up to try and reproduce the main features of experimental results, which include upper and lower pressure and electric field thresholds, discharge formation time, particle loss and injection, and initial rates of increase of current and temperature. The model is compared with experiments on devices built at Fontenay-aux-Roses (TA2000 and TFR). Some of the discrepancies between model and experiment may be due to the existence of early runaways. The absence of an efficient, uniform pre-ionization on TFR could be responsible for the appearance of these runaways. Finally, it is concluded that impurities from the walls and limiter flow into the TFR plasma right from the start; the rate of influx is estimated for the first few milliseconds. This influx itself is considered as indicative of early runaways. (auth)

5286 (HEDL-SA-947) ANALYSIS OF IRRADIATION WITH TIME-DEPENDENT SOURCES. Schiffgens, J. O.; Graves, N. J.; Doran, D. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-2170. 42p. (CONF-751026-16). Dep. NTIS $5.25.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Various CTR designs call for pulsed operation with cycle lengths ranging from several seconds to about a hundred minutes, and pulse lengths ranging from nanoseconds to the neighborhood of ninety minutes. Fluctuations in temperature, stress, and damage rate resulting from pulsed reactor operation are expected to significantly affect component life. This paper describes the first phase of an analysis of effects resulting from damage rate fluctuations. Procedures for modeling cluster growth are discussed and the results of calculations of the net growth of gas containing voids during an irradiation cycle are presented. These calculations show that the pulse parameters chosen for reactors and irradiation sources can dramatically alter swelling, and most probably other irradiation effects. For example, if the irradiation pulse length is less than about 10 mu sec and the interval between pulses is greater than about ten vacancy mean lives, no void growth is possible in stainless steel regardless of temperature, dislocation density and pulse amplitude (instantaneous displacement rate) provided no voids form in displacement cascades which are large enough to survive the time between pulses. (auth)

5287 (HEDL-SA-948) APPLICATION OF DAMAGE FUNCTIONS TO CTR COMPONENT FLUENCE LIMIT PREDICTIONS. Simons, R. L.; Doran, D. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract E(45-1)-2170. 24p. (CONF-751026-22). Dep. NTIS $4.25.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Material behavior observed under irradiation conditions in test reactors is not always directly applicable to the design of reactor components such as CTR first wall because of differences in the damage effectiveness of test reactor and service spectra. The interpolation and, under some conditions, extrapolation of material property change data from test conditions to different neutron spectra in service conditions can be accomplished using semi-empirical damage functions. The derivation and application of damage functions to CTR conditions is reviewed. Since limited amounts of data are available for applications to CTR design spectra, considerable attention is placed on the effectiveness of various available and proposed neutron sources in determining a damage function and subsequent fluence limit prediction. Neutron sources included in this study were EBR-II, HIFR, LAMPF (Be and Cu targets), high energy deuterons incident on Be (D-Be), and 14 MeV neutrons (D-T). (auth)

5288 (HEDL-SA-951) DIMENSIONAL STABILITY OF STAINLESS STEEL AS AFFECTED BY COMPOSITIONAL TRANSMUTATIONS. Bates, J. F.; Schiffgens, J. O.; Paxton, M. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-217. 17p. (CONF-751026-17). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Some effects of transmutations of Mn, Ni, Ti and V in 316 stainless steel which would be expected in a first wall CTR application were evaluated. Based on the available data and relevant investigations, it is concluded that little or no deleterious effects on the recrystallization temperature or 1400^{0}F tensile properties will be experienced by the steel as a result of these transmutations. Small lattice strains (less than 0.1 percent for 30 years' residence time) will be experienced due to changes in Mn and Ni content. In conclusion, the results show that a 316 stainless steel first wall of a controlled thermonuclear reactor could operate up to 30 years with no serious change in tensile properties or recrystallization temperature, although small changes in dimensions due to lattice strain would occur. If 20 percent cold worked 316 is used, the material would be thus swelling and limited in its use. No significant change in the swelling behavior of the original alloy would be expected from the solid transmutations. (auth)

5289 (HEDL-TME--75-90) CONTROLLED THERMONUCLEAR RESEARCH. Quarterly Report, April--June 1975. Doran, D. G.; Yoshikawa, H. H. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-2170. 41p. Dep. NTIS $5.45.

The initial results are given of a study of the effects of pulsing of a neutron source on the nucleation of defect microstructures. It is shown that significant throttling of nucleation rates may occur in irradiation systems of interest. Previous work concerned with the influence of cascade-produced vacancy clusters on nucleation of voids has been extended to include the effect of these clusters on the vacancy supersaturation. If the vacancy-cluster binding energy is sufficiently high, the previously found nucleation enhancement can give way to a diminution due to the decreased vacancy supersaturation. New displacement damage cross sections based on ENDF/B-IV data are given for Al, Ni, Cu, Zr, W, and Pb. Preliminary attempts to estimate displacement cross sections for energetic protons in nickel suggest Rutherford-based values are low by perhaps 40 percent at 20 MeV and 60 percent at 30 MeV. A brief description is given of irradiations performed at LLL with the RTNS to measure helium production cross sections at 14 MeV. (auth)

5290 (LA-UR-75-351) APPLICATION OF BONDARENKO FORMALISM TO FUSION REACTORS. Soran, P. D.; Dudziak, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 8p. (CONF-750364-1). Dep. NTIS $4.50.

From conference on neutron cross section and technology; Washington, District of Columbia, USA (3 Mar 1975).

The Bondarenko formalism used to account for resonance self-shielding effects (temperature and composition) in a Reference Theta-Pinch Reactor is reviewed. A material of interest in the RTPR blanket is ^{93}Nb, which exhibits a large number of capture resonance in the energy region below 800 keV. Although Nb constitutes a small volume fraction of the blanket, its presence significantly affects the nucleonic properties of the RTPR blanket. The effects of self-shielding in ^{93}Nb on blanket parameters such as breeding ratio, total afterheat, radioactivity, magnet-coil heating and total energy depositions have been studied. Resonance self-shielding of ^{93}Nb, as compared to unshielded cross sections, will increase tritium breeding by approximately 7 percent in the RTPR blanket and will decrease blanket radioactivity, total recoverable energy, and magnet-coil heating. Temperature effects change these parameters by less than 2 percent. The method is not restricted to the RTPR, as a single set of Bondarenko f-factors

is suitable for application to a variety of fusion reactor designs. (auth)

5291 (LA-UR-75-1565) HIGH DENSITY LINEAR SYSTEMS FOR FUSION POWER. Ellis, W. R.; Krakowski, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750944-19). Dep. NTIS $4.00.

From 3rd topical conference on pulsed high beta plasmas; Abingdon, Oxfordshire, UK (9 Sep 1975).

The physics and technological limitations and uncertainties associated with the linear theta pinch are discussed in terms of a generalized energy balance, which has as its basis the ratio (Q/sub E/) of total electrical energy generated to net electrical energy consumed. Included in this total is the virtual energy of bred fissile fuel, if a hybrid blanket is used, as well as the actual of real energy deposited in the blanket by the fusion neutron. The advantages and disadvantages of the pulsed operation demanded by the linear theta pinch are also discussed. (MOW)

5292 (LA-UR-75-1846) EFFECTS OF IONIZING RADIATION OF ELECTRICAL PROPERTIES OF REFRACTORY INSULATORS. van Lint, V. A. J.; Bunch, J. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 18p. (CONF-751026-24). Dep. NTIS $4.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

The Los Alamos Reference Theta Pinch Reactor (RTPR) requires on the first wall an electrical insulator which will withstand transient high voltage at high temperature 10 sec after severe neutron and ionizing irradiation. Few measurements of electrical parameters for heavily disordered refractory insulators have been reported; estimates are made as to whether breakdown strength or conductivity will be degraded by the irradiation. The approach treats separately short-term ionization effects (free and trapped electrons and holes) and long-term gross damage effects (transmutation products and various lattice defects). The following processes could produce unacceptable conduction across the first wall insulator: (a) delayed electronic conductivity 10 sec after the prompt ionization by bremsstrahlung; (b) prompt electronic conductivity from delayed ionization; (c) electronic breakdown; (d) electronic or ionic conductivity due to thermal motion in the disordered material, possibly leading to thermal breakdown. Worst-case calculations based on lower limits to recombination coefficients limit process (a) to sigma much less than 5×10^{-14} mho/cm. Data on ionization-induced conductivity in insulators predict for process (b) sigma much less than 10^{-8} mho/cm. Electronic breakdown generally occurs at fields well above the 10^5 V/cm required for RTPR. Thermal breakdown is negligible due to the short voltage pulse. Ionic and electronic conduction must be studied theoretically and experimentally in the type of highly disordered materials that result from neutron irradiation of the first wall. (auth)

5293 (LA-UR-75-2115) 10 kA LOW RESISTANCE SUPERCONDUCTING SWITCH. Lindsay, J. D. G.; Blevins, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-751125-57). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A low resistance superconducting switch for use in initiating transfer of energy from an inductive energy storage coil has been constructed and tested at Los Alamos Scientific Laboratory. The switch will be used in series with a mechanical circuit breaker to reduce the current through the breaker prior to its opening. Both mechanical breaker and switch are immersed in liquid helium. Opening the switch before the mechanical breaker will reduce arcing and burning of the mechanical breaker contacts and reduce the rate at which the heat generated during the switching operation is deposited into the helium bath. A detailed description of the switch design and construction is given as well as the initial design parameters and test results. A circuit diagram of the switching scheme and a discussion of the circuit is also given. (auth)

5294 (LA-UR-75-2127) HVDC INTERRUPTER EXPERIMENTS FOR LARGE MAGNETIC ENERGY TRANSFER AND STORAGE (METS) SYSTEMS. Swannack, C. E.; Haarman, R. A.; Lindsay, J. D. G.; Weldon, D. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-751125-56). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Proposed fusion-test reactors will require energy storage systems of hundreds of megajoules with transfer times of the order of one millisecond. The size of the energy storage submodule (and, hence, the overall system cost and complexity) is directly determined by the voltage and current limits of the switch used for the energy transfer. Experiments are being conducted on high voltage dc circuit breakers as a major part of the energy storage, pulsed power program. DC circuit interruption characteristics of a commercially available ac power vacuum interrupter are discussed. Preliminary data of interruption characteristics are reported for an interrupter developed specifically to match a present METS circuit requirement. (auth)

5295 (LRP-94/75) INFLUENCE OF STRONGLY FLUX-LIMITED ELECTRON THERMAL CONDUCTION ON BURN OF LASER IMPLODED DT SPHERES. Appert, K. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Jul 1975. 11p. Dep. NTIS (US Sales Only) $4.50.

It is shown by numerical calculations using MEDUSA, a one-dimensional Lagrangian hydrodynamics code, that low thermal conductivity makes it difficult to tune the laser pulse: the region of pulse parameters leading to positive energy gain shrinks seriously with decreasing thermal conductivity. (MOW)

5296 (MATT--1158) PRINCETON FUSION POWER PLANT SUPERCONDUCTING MAGNET SYSTEM AND COSTS. File, J. (Princeton Univ., N. J. (USA). School of Engineering and Applied Science). Oct 1975. Contract E(11-1)-3073. 27p. (CONF-750438--9). Dep. NTIS $4.00.

From fifth international conference on magnet technology; Frascati, Italy (21 Apr 1975).

The Princeton University Reference Design of a proposed fusion power plant has been previously described. This paper describes details of the superconducting magnet system consisting of toroidal field, divertor, ohmic heating, equilibrium field and control field magnets, all of which are wound of Nb_3Sn conductor. The toroidal field coils are of the moment-free, "D" type, previously described. The toroidal field magnet is comprised of 48 discrete "D" coils, 12m x 19m bore. The magnet has a stored energy of 250×10^9 joules. The magnet which is operated at a maximum field of 16T is described in detail. Fault conditions are calculated and design conditions based on maximum fault forces are outlined. In addition, the Dewar System, the refrigeration plant (requiring 280 kW of refrigeration), the safety system, and the coil protection system for the magnets are described. Finally, an overview of the helium-steam generating plant and detailed cost data for the plant, the nuclear island and the magnet are presented. (auth)

5297 (MATT-1187) ON CURRENT PENETRATION AND PLASMA DISRUPTION. Stix, T. H. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. Contract E(11-1)-3073. 14p. Dep. NTIS $4.00.

It is suggested that, in a tokamak discharge, the initial rapid current penetration and the disruptive instability may each be attributed to a type of nonlinear double tearing instability which causes growth and overlap of radially separated magnetic islands. The ensuing reconnection and braiding of magnetic lines would enhance local radial heat and particle transport and could permit rapid redistribution of plasma current, inducing positive or negative spikes in the loop-voltage signal. (auth)

5298 (MATT--1159) TOROIDAL FIELD COILS FOR THE PRINCETON DIVERTOR EXPERIMENT. Citrolo, J. C.; Bushnell, C. W. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Oct 1975. Contract E(11-1)-3073. 20p. (CONF-750438--10). Dep. NTIS $4.00.

From fifth international conference on magnet technology; Frascati, Italy (21 Apr 1975).

The toroidal field coils for the Princeton Divertor Experiment (PDX) and their supporting structure are described. The special demountable nature of the coils and the problems which result from this feature are discussed. The procedures for assembly and fabrication of the coils are presented. (auth)

5299 (ORNL-TM-5042) OAK RIDGE TOKAMAK EXPERIMENTAL POWER REACTOR STUDY REFERENCE DESIGN. Roberts, M.; Bettis, E. S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 133p. Dep. NTIS $7.60.

A Tokamak EPR Reference Design is presented as a basis for further design study leading to a Conceptual Design. The set of basic plasma parameters selected--minor radius of 2.25 m, major radius of 6.75 m, magnetic field on axis of 4.8 T and plasma current of 7.2 MA--should produce a reactor-grade plasma with a significant neutron flux, even with the great uncertainty in plasma physics scaling from present experience to large sizes. Neutronics and heat transfer calculations coupled with mechanical design and materials considerations were used to develop a blanket and shield capable of operating at high temperature, protecting the surrounding coils, being maintained remotely and, in a few experimental modules, breeding tritium. Nb_3Sn and NbTi superconductors are used in the toroidal field coil design. The

coil system was developed for a maximum field of 11 T at the winding (to give a field on axis of 4.8 T), and combines multifilamentary superconducting cable with forced flow of supercritical helium enclosed in a steel conduit. The structural system uses a stainless steel center bucking ring and intercoil box beam bracing to provide rigid support for coils against the centering force, overturning moments from poloidal fields and faults, other external forces, and thermal stresses. The poloidal magnetics system is specially designed both to reduce the total volt-second energy requirements and to reduce the magnitude of the rate of field change at the toroidal field coils. The rate of field change imposed upon the toroidal field coils is reduced by at least a factor of 3.3 compared to that due to the plasma alone. Tritium processing, tritium containment and vacuum systems employ double containment and atmospheric cleanup to minimize releases. The document also contains discussions of systems integration and assembly, key research and development needs, and schedule considerations. (auth)

5300 (SAND-75-5393) ATOMIC DISPLACEMENT DISTRIBUTIONS FOR LIGHT ENERGETIC ATOMS INCIDENT ON HEAVY ATOM TARGETS. Brice, D. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 11p. (CONF-751006-7). Dep. NTIS $4.00.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

The depth distributions of atomic displacements produced by 4 to 100 keV H, D, and He ions incident on Cr, Mo, and W targets have been calculated using a sharp displacement threshold, E/sub d/ equals 35 eV, and a previously described calculational procedure. These displacement depth distributions have been compared with the depth distributions of energy deposited into atomic processes to determine if a proportionality (modified Kinchin–Pease relationship) can be established. Such a relationship does exist for He ions and D ions incident on these metals at energies above 4 keV and 20 keV, respectively. For H ions the two distributions have significantly different shapes at all incident energies considered. (auth)

5301 (SAND--75-5437) TECHNIQUES FOR STUDYING HYDROGEN AND HELIUM ISOTOPES IN MATERIALS: ION BACKSCATTERING AND NUCLEAR MICROANALYSIS. Langley, R. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 17p. (CONF-751026--10). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

The techniques of ion backscattering and nuclear microanalysis as tools for studying hydrogen and helium isotopes in solid materials are discussed and compared. The advantages, disadvantages and limitations of each of these techniques are explored. Experimental results obtained using the two techniques are analyzed to obtain information on concentration-versus-depth profiles for these light atoms in heavy atom substrates. Measurements of the elastic scattering cross section for the $^3H(p,p)^3H$ interaction are also discussed. (auth)

5302 (SAND-75-5520) SPUTTERING OF ErD_2: EXPERIMENT AND THEORY. EerNisse, E. P.; Brice, D. K. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 17p. (CONF-750965-2). Dep. NTIS $4.00.

From international conference on atomic collisions in solids; Amsterdam, Netherlands (22 Sep 1975).

Experimental measurements were made of the sputtering yield of ErD_2 targets bombarded by D and A ions in the energy range 50-400 keV. A semiempirical sputtering theory is presented that relates sputtering to the energy deposited into atomic collisions beneath the target surface as well as at the surface. The theory accurately predicts the sputtering yields for both D and A bombardment. Additional calculated sputtering yields for ErD_2 targets are presented which should allow extrapolation to any ion in the range of Z equals 1 to Z equals 36 with an accuracy better than 50 percent. (auth)

5303 (SAND--75-5751) ION BEAM GENERATION AND FOCUSING. Miller, P. A.; Mendel, C. W.; Swain, D. W.; Goldstein, S. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 22p. (CONF-751108--5). Dep. NTIS $4.50.

From first international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Calculations have shown that efficiently generated and focused ion beams could have significant advantages over electron beams in achieving ignition of inertially confined thermonuclear fuel. Efficient ion beam generation implies use of a good ion source and suppression of net electron current. Net electron flow can be reduced by allowing electrons to reflex through a highly transparent anode or by use of transverse magnetic fields (either beam self-fields or externally applied fields). Geometric focusing can be achieved if the beam is generated by appropriately shaped electrodes. Experimental results are presented which demonstrate ion beam generation in both reflexing and pinched-flow diodes. Spherically shaped electrodes are used to concentrate a proton beam, and target response to proton deposition is studied. (auth)

5304 (SAND--75-5765) ANODE PLASMA AND FOCUSING REB DIODES. Goldstein, S. A.; Swain, D. W.; Hadley, G. R.; Mix, L. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 27p. (CONF-751108--9). Dep. NTIS $5.00.

From first international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

The use of electrical, optical, x-ray, and particle diagnostics to characterize the production of anode plasma and to monitor its influence on beam generation and focusing is reviewed. Studies using the Nereus accelerator show that after cathode turn-on, deposition of several kJ/gm on the anode is necessary before ions from hydrocarbons, adsorbed gases, and heavier metallic species are detected. The actual time at which ions are liberated depends on several factors, one of which is the specific heat of the anode substrate. Once formed, anode ions cross the A-K gap (with an energy equal to the diode voltage) and interact with the cathode to produce an axially peaked beam profile, a "pinch" which does not follow the critical current criterion. Experiments with externally generated anode plasma show that this type of pinch can be attracted to localized areas on the anode. Preliminary observations on Hydra indicate the anode plasma composition is similar to that on Nereus. The effect of this plasma on pinch dynamics currently is under investigation. (auth)

5305 (SAND-75-5802) PROTO-II: A SHORT PULSE WATER INSULATED ACCELERATOR. Martin, T. H.; VanDevender, J. P.; Johnson, D. L.; McDaniel, D. H.; Aker, M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 29p. (CONF-751108-7). Dep. NTIS $5.00.

From 1st international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

A new accelerator, designated Proto-II, is presently under construction at Sandia Laboratories. Proto-II will have a nominal output of 100 kJ into a two-sided diode at a voltage of 1.5 MV and a total current of over 6 MA for 24 ns. This accelerator will be utilized for electron beam fusion experiments and for pulsed power and developmental studies leading to a proposed further factor of five scale-up in power. The design of Proto-II is based upon recent water switching developments and represents a 10-fold extrapolation of those results. Initial testing of Proto-II is scheduled to begin in 1976. Proto-II power flow starts with eight Marx generators which charge 16 water-insulated storage capacitors. Eight triggered, 3 MV, SF_6 gas-insulated switches next transfer the energy through oil-water interfaces into the first stage of 16 parallel lines. Next, the 16 first stages transfer their energy into the pulse forming lines and fast switching sections. The energy is then delivered to two converging, back-to-back, disk-shaped transmission line. Two back-to-back diodes then form the electron beams which are focused onto a common anode. (auth)

5306 (SAND-75-5803) PROTO-I SWITCHING AND DIODE STUDIES. Prestwich, K. R.; Miller, P. A.; McDaniel, D. H.; Poukey, J. W.; Widner, M. M.; Goldstein, S. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 43p. (CONF-751108-12). Dep. NTIS $5.00.

From 1st international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

Proto-I is a 3 MV, 800 kA, 24 ns electron beam accelerator that is under development at Sandia Laboratories. It represents an initial effort to develop a scalable technology that is applicable to accelerators for electron beam driven, inertial confinement fusion studies. Energy is supplied to each of the two diodes from six oil-dielectric Blumlein transmission lines (PFL) operating in parallel. A Marx generator charges three intermediate storage, water-dielectric capacitors which subsequently transfer the stored energy to the PFL. The discharge of the PFL is initiated by the simultaneous closure of 12 triggered oil-dielectric rail switches. Data will be presented on the operation of these multichannel switches. The two diodes have a common anode. Cathode diameters can be varied from 10 to 60 cm. Results of initial diode experiments and comparisons with theory are discussed. Plasma filled diode experiments are also reported, indicating pinch collapse velocities in excess of 10^9 cm/s. (auth)

5307 (SAND-75-8653) CONTAINMENT AND DECONTAMINATION SYSTEMS PLANNED FOR THE TRITIUM RESEARCH

LABORATORY BUILDING AT SANDIA LABORATORIES, LIVERMORE. Gildea, P. D. (Sandia Labs., Livermore, Calif. (USA)). Oct 1975. Contract AT(29-1)-789. 21p. (CONF-751026-30). Dep. NTIS $4.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Sandia Laboratories, Livermore, is constructing a new facility, the Tritium Research Laboratory, that incorporates containment and cleanup facilities which hold any tritium that is accidentally released rather than allow the material to be vented to the atmosphere. This containment is achieved with hermetically sealed glove boxes that are connected on demand by manifolds to two central decontamination systems called the Gas Purification System (GPS) and the Vacuum Effluent Recovery System (VERS). The primary function of the GPS is to remove tritium and tritiated water vapor from the glove box atmosphere. The primary function of the VERS is to decontaminate the gas exhausted from the vacuum pumps in the building before venting this gas to the stack. (auth)

5308 (STI/PUB-381(Vol.1)) PLASMA PHYSICS AND CONTROLLED NUCLEAR FUSION RESEARCH, 1974. Volume I. Proceedings Series. Proceedings of the Fifth International Conference, Tokyo, Japan, November 11–15, 1974. (International Atomic Energy Agency, Vienna (Austria)). Jun 1975. 725p. (In Several Languages). (CONF-741105-P1). IAEA $44.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Separate abstracts were prepared for 62 of the included papers and are included in Nuclear Science Abstracts. Twenty-three of the papers appear in ERDA Research Abstracts. (MOW)

For abstracts of individual papers see: 5122–5146, 5180–5182, 5188–5192, 5205–5214, 5245–5254, 5326–5333, and 5386.

5309 (STI/PUB-(Vol.2)) PLASMA PHYSICS AND CONTROLLED NUCLEAR FUSION RESEARCH, 1974. Volume II. Proceedings Series. Proceedings of the Fifth International Conference, Tokyo, Japan, November 11–15, 1974. (International Atomic Energy Agency, Vienna (Austria)). Jul 1975. 791p. (In Several Languages). (CONF-741105-P2). IAEA $47.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Separate abstracts were prepared for 63 of the papers. These were included in Nuclear Science Abstracts. In addition, abstracts for 19 of the papers appear in ERDA Research Abstracts. (MOW)

For abstracts of individual papers see: 5147–5163, 5193, 5215–5219, 5233, 5255–5257, 5334–5362, and 5387–5393.

5310 (UCRL-51797) PROGRESS ON THE CONCEPTUAL DESIGN OF A MIRROR HYBRID FUSION–FISSION REACTOR. Moir, R. W.; Lee, J. D.; Burleigh, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jun 1975. Contract W-7405-Eng-48. 155p. Dep. NTIS $7.60.

A conceptual design study was made of a fusion-fission reactor for the purpose of producing fissile material and electricity. The fusion component is a D-T plasma confined by a pair of magnetic mirror coils in a Yin-Yang configuration and is sustained by neutral beam injection. The neutrons from the fusion plasma drive the fission assembly which is composed of natural uranium carbide fuel rods clad with stainless steel and helium cooled. It was shown conceptually how the reactor might be built using essentially present-day technology and how the uranium-bearing blanket modules can be routinely changed to allow separation of the bred fissile fuel. (MOW)

5311 (UCRL--76573) MAGNETIC AND INERTIAL CTR: PRESENT STATUS AND OUTLOOK. Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jan 1975. 31p. (CONF-750110--8). Dep. NTIS $5.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

Some of the successes of controlled fusion research in both inertial confinement and magnetic confinement are described. The possibilities of scaled-up experiments are also discussed with respect to cost and economics. (MOW)

5312 (UCRL--76706) ESTIMATED D_2-DT-T_2 PHASE DIAGRAM IN THE THREE-PHASE REGION. Souers, P. C.; Hickman, R. G.; Tsugawa, R. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Aug 1975. 16p. (CONF-751026--11). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

A composite of experimental eH_2-D_2 phase-diagram data at the three-phase line is assembled from the literature. The phase diagram is a smooth cigar shape without a eutectic point, indicating complete miscibility of liquid and solid phases. Additional data are used to estimate the D_2-T_2, D_2-DT, and DT-T_2 binary phase diagrams. These are assembled into the ternary D_2-DT-T_2 phase diagram. A surface representing the chemical equilibrium of the three species is added to the phase diagram. At chemical equilibrium, it is estimated that 50-50 liquid D-T at 19.7 K is in equilibrium with 42 mole percent T vapor and 54 percent T solid. Infrared spectroscopy is suggested as a means of component analysis of liquid and solid mixtures. (auth)

5313 (UCRL--76707) SECONDARY CONTAINMENT SYSTEM FOR A HIGH TRITIUM RESEARCH CRYOSTAT. Tsugawa, R. T.; Fearon, D.; Souers, P. C.; Hickman, R. G.; Roberts, P. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Sep 1975. 11p. (CONF-751026--12). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

A 4.2- to 300-K liquid helium cryostat was constructed for cryogenic samples of D-T containing up to 4×10^{14} dis/s (10,000 Ci) of tritium radioactivity. The cryostat is enclosed in a secondary box, which acts as the ultimate container in case of a tritium release. Dry argon is flushed through the box, and the box atmosphere is monitored for tritium, oxygen, and water vapor. A rupture disk and abort tank protect the box atmosphere in case the sample cell breaks. If tritium breaks into the box, a powdered uranium getter trap reduces the 4×10^{14} dis/s (10,000 Ci) to 4×10^{9} dis/s (0.1 Ci) in 24 h. A backup palladium-zeolite getter system goes into operation if an overabundance of oxygen contaminates the uranium getter. (auth)

5314 (UCRL--76734) COLLECTION OF DEUTERIUM ON A URANIUM GETTER DURING DYNAMIC FLOW CONDITIONS. Folkers, C. L.; Singleton, M. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1975. Contract W-7405-Eng-48. 13p. (CONF-751026--19). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

We have studied uranium as a getter material under varying flow conditions using a uranium trap designed to remove tritium from inert gases. The uranium trap can remove any hydrogen isotope from an inert gas. We used mixtures of deuterium in argon at room temperatures. In the case of tritium, recovery is effected by heating the trap. A special segmented trap was designed to prevent channeling and to promote maximum reaction rates when gas flows through it. The gas mixtures were sampled at the trap inlet and outlet and were analyzed by a mass spectrometer. The results are expressed as a purification factor, which is the ratio of deuterium concentration at the inlet of the uranium trap to the concentration at the outlet. Purification factors vary inversely with both the ratio of deuterium to uranium already contained in the trap and with the rate of flow of gas through the trap. The effects of varying inlet deuterium concentrations on purification factors are also discussed. (auth)

5315 (UCRL-76761) ANALYSES AND HYDROGEN-ISOTOPE-TRANSPORT CALCULATIONS OF CURRENT AND FUTURE DESIGNS OF THE LLL ROTATING-TARGET NEUTRON SOURCE. Steward, S. A.; Nickerson, R.; Booth, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Sep 1975. 19p. (CONF-751026-9). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Analyses of the present titanium-tritide RTNS targets are presented. These results include the hydrogen-isotope content of new and used targets, metallography, scanning electron microscopy, and hydrogen-isotope-diffusion calculations using a heat-flow finite-difference computer code. These latter calculations indicate that a combination of long target life and high neutron output is optimized when the rate of hydrogen isotope evolution from the target balances the deposition rate from the beam. Auger spectra show that carbon and oxygen species are present in the bulk and on the surface. (auth)

5316 (UCRL--76765) HELIUM GENERATION IN COPPER BY 14.8-MeV NEUTRONS. Holt, J. B.; Hosmer, D. W.; Van Konynenburg, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Sep 1975. Contract W-7405-Eng-48. 11p. (CONF-751026--7). Dep. NTIS $4.00.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

High purity copper foils were irradiated with 14.8-MeV neutrons from the rotating target neutron source facility at LLL. The average energy of the neutrons was 14.75 +- 0.1 MeV, and the

average fluence was 7.0×10^{16} n/cm^2. After irradiation each foil was heated to the melting point and the released helium was measured by a mass spectrometer of special design. Isochronal heating was carried out on several samples to establish the type and temperature of maximum release. Calculated cross sections from the literature for the (eta, alpha) and (eta, eta'alpha) nuclear reactions were used, and the predicted amount of helium was consistently about 0.5 of that actually measured. Because there is very little data on helium generation in metals irradiated with high energy neutrons, these results are important and will be related to potential CTR materials. (auth)

5317 (UCRL-76911) FUSION POWER AND THE ENVIRONMENT. Holdren, J. P.; Fowler, T. K.; Post, R. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jun 1975. 22p. (CONF-750697-1). Dep. NTIS $4.00.

From proceedings of energy and the environment – cost benefit analysis; Atlanta, Georgia, USA (23 Jun 1975).

Environmental characteristics of conceptual fusion-reactor systems based on magnetic confinement are examined quantitatively, and some comparisons with fission systems are made. Fusion, like all other energy sources, will not be completely free of environmental liabilities, but the most obvious of these--tritium leakage and activation of structural materials by neutron bombardment--are susceptible to significant reduction by ingenuity in choice of materials and design. Large fusion reactors can probably be designed so that worst-case releases of radioactivity owing to accident or sabotage would produce no prompt fatalities in the public. A world energy economy relying heavily on fusion could make heavy demands on scarce nonfuel materials, a topic deserving further attention. Fusion's potential environmental advantages are not entirely "automatic", converting them into practical reality will require emphasis on environmental characteristics throughout the process of reactor design and engineering. The central role of environmental impact in the long-term energy dilemma of civilization justifies the highest priority on this aspect of fusion. (auth)

5318 (UCRL--77057) BEHAVIOR OF FLUID INSTABILITIES IN LASER FUSION PELLETS: RESULTS OF 2-D CALCULATIONS. Mead, W. C.; Lindl, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1975. 20p. (CONF-750841--1). Dep. NTIS $4.00.

From Gordon research conference on laser interaction with matter; Tilton, New Hampshire, USA (18 Aug 1975).

Two-dimensional Lagrangian hydrodynamics simulation techniques were used to study fluid instability in laser fusion pellets. A slab geometry comparison with classical Rayleigh-Taylor theory shows good agreement, as do other slab and spherical test problems over a wide range of accelerations and wavelengths. Isentropic ablative accelerations exhibit growth rates 50 percent-100 percent of classical values, while non-isentropic cases show suppressed growth. Design optimization at 100 kJ input energy has led to an impulsively accelerated, low-aspect-ratio shell which operates successfully with a surface perturbation of a few tens of angstroms. Comparison of simulations with present experiments indicates that current neutron-producing targets are insensitive to damage from fluid instability. (auth)

5319 (UCRL-77229) ELECTRICAL INSULATION FOR LARGE MULTIAXIS SUPERCONDUCTING MAGNETS. Harvey, A. R.; Rinde, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1975. 5p. (CONF-751125-31). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The selection of interturn and interlayer insulation for superconducting magnets is discussed. The magnet problems of the Baseball II device are described. Manufacture of the insulation and radiation damage are mentioned. A planned experimental program is outlined. (MOW)

5320 (UCRL-77237) FUSION REACTORS: A REMOTE POSSIBILITY. Doggett, J. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1975. 5p. (CONF-751125-32). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The next generation of controlled thermonuclear reactor experiments will be faced with the handling problems of tritium and neutron activation that will dominate the safety and maintenance problems of future fusion reactors. The nuclear industry has been working with highly radioactive systems for many years and has developed the tools and methods to do safely productive work in the presence of high radiation fields. These methods can be applied to CTR work by extending them to the unique problems associated with fusion reactors. (auth)

5321 (UCRL-77240) VACUUM SYSTEM FOR THE LIVERMORE INTENSE NEUTRON SOURCE. Hanson, C. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1975. 5p. (CONF-751125-33). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

To fulfill the need for intense 14-MeV neutron sources for controlled thermonuclear reactor material damage studies, several accelerators will be built at the Lawrence Livermore Laboratory. A high-capacity vacuum system will be required to handle the large deuterium gas load needed to produce the beam current. Outgassing of tritium from the target necessitates special handling of the exhaust from the vacuum pumps. A vacuum system utilizing turbomolecular pumps was selected after comparing its performance with mercury vapor diffusion and titanium bulk sublimation/ion pumps. (auth)

5322 (UCRL-77245) 2XIIB STATUS. Bulmer, R. H.; Calderon, M. O.; Hibbs, S. M.; Kozman, T. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125-27). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The 2XIIB CTR facility at LLL is described with emphasis on the engineering aspects of recent modifications. The current version of the 2X series of magnetic confinement experiments has been operating since the fall of 1974. The 2XIIB relies on pulsed-mirror coils to trap axially-injected low-energy ions. Subsequent heating of the ions is accomplished by energizing additional mirror coils to compress the plasma. Experiments prior to 2XIIB demonstrated plasma trapping and confinement in the pulsed mode. The new feature of 2XIIB is intense beams of electrically neutral atoms that heat the target plasma and sustain its classical losses. The principal goal of on-going experiments is to demonstrate scaling of the eta tau product with mean ion energy via neutral beam injection. This paper is an overview of the engineering developments of the past two years and an introduction to more detailed reports presented at this symposium. (auth)

5323 (UCRL-77263) ANALYSIS OF THE STEADY-STATE OPERATION OF VACUUM SYSTEMS FOR FUSION MACHINES. Roose, T. R.; Hoffman, M. A.; Carlson, G. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Nov 1975. Contract W-7405-Eng-48. 8p. (CONF-751125-30). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A computer code named GASBAL was written to calculate the steady-state vacuum system performance of multi-chamber mirror machines as well as rather complex conventional multi-chamber vacuum systems. Application of the code, with some modifications, to the quasi-steady tokamak operating period should also be possible. Basically, GASBAL analyzes free molecular gas flow in a system consisting of a central chamber (the plasma chamber) connected by conductances to an arbitrary number of one- or two-chamber peripheral tanks. Each of the peripheral tanks may have vacuum pumping capability (pumping speed), sources of cold gas, and sources of energetic atoms. The central chamber may have actual vacuum pumping capability, as well as a plasma capable of ionizing injected atoms and impinging gas molecules and "pumping" them to a peripheral chamber. The GASBAL code was used in the preliminary design of a large mirror machine experiment--LLL's MX. (auth)

5324 (UCRL-77357) DT FUSION NEUTRON RADIATION STRENGTHENING OF COPPER AND NIOBIUM. Mitchell, J. B.; Van Konynenburg, R. A.; Echer, C. J.; Parkin, D. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Sep 1975. 62p. (CONF-751026-20). Dep. NTIS $5.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

The initial results of a comparative study of the radiation strengthening and damage structures produced in Cu and Nb by D-T fusion and fission reactor neutrons are described. The radiation strengthening produced by a given fluence of fusion neutrons above about 10^{17} n/cm^2 is equal to that produced by a fluence of fission reactor neutrons (E greater than 0.1 MeV) ten times as great. This difference is about twice as large as would be expected if the strengthening scaled with damage energy or dpa. Initial transmission electron microscopy observations of the damage structures in fusion and fission reactor neutron irradiated copper indicate that the same type of primary structural defects, vacancy and interstitial point defect clusters and small dislocation loops with a/3 (111) and a/2 (110) Burgers vectors, are produced in both cases. The difference in the radiation

strengthening produced by fusion and fission reactor neutrons in Cu appears to result from a substantially greater rate of accumulation of damage, in the form of point defect clusters, during irradiation with fusion neutrons than during irradiation with fission reactor neutrons plus a significant difference in the size and spatial distributions of the damage clusters. (auth)

5325 (UCRL-Trans--10942) INTERACTION OF A HIGH-POWER LASER BEAM WITH AN LiD TARGET. Dubovoi, L.V.; Dyatlov, V. D.; Kryzhanovskii, V. I.; Mak, A. A.; Medvedev, R. N.; Popytaev, A. N.; Serebryakov, V. A.; Sizov, V. N.; Starikov, A. D. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Sep 1975. Translation of NP--20299. 16p. Dep. NTIS $4.50.

A study is presented of the parameters of a plasma produced by a high-power Nd glass laser irradiating an LiD target. Neutron yields of up to 6×10^5 neutrons/4 pi and electron temperatures of 1 to 2 keV were measured. The reflection coefficient was found as a function of the incident beam intensity. This relationship cannot be explained by a classical interaction mechanism. (auth)

5326 RESEARCH ON A TOKAMAK WITH AN AXISYMMETRIC DIVERTOR AND IMPURITY PROBLEMS IN TOKAMAK DEVICES. Yoshikawa, M.; Tazima, T.; Shimomura, Y. (Japan Atomic Energy Research Inst., Tokai). pp 17-29 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

Experimental and theoretical research work on impurity problems in tokamak plasma confinement carried out at JAERI is described. Initial experiments in a tokamak with an axisymmetric divertor indicate that a positionally stable plasma equilibrium enclosed in a separatrix magnetic surface is obtained and that the gross behavior of the plasma is rather similar to that of conventional tokamak plasmas. Theoretical studies on impurity problems are made in impurity density distributions, radiation losses, and time evolution of impurity content; they indicate that the relevant problems have to be studied seriously before a large tokamak device of the next generation can be designed. (auth)

5327 PERTURBATION OF A MAGNETIC FIELD DURING THE BREAK-UP INSTABILITY IN TOKAMAK-6. Vlasenkov, V. S.; Leonov, V. M.; Merezhkin, V. G.; Mukhovatov, V. S. (Inst. of Atomic Energy, Moscow). pp 33-42 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol.1); CONF-741105-P1.

The results of measuring perturbations in a poloidal field during the development of the break-up instability in Tokamak-6 are presented. The following discharge parameters were applied: plasma current $I \sim 50$ kA, longitudinal magnetic field strength $H_0 = 5-6$ kOe, $2q < (a) < 3$. It was demonstrated that the break-up instability was accompanied by large-scale perturbations in the magnetic field, associated with distortion in the shape of the plasma column. In the vicinity of the discharge chamber walls, the amplitude was $\sim 20\%$ of that of the unperturbed field. It was also shown that the structure of these perturbations underwent substantial changes during the development of the instability. (auth)

5328 EFFECT OF CORRUGATION OF THE LONGITUDINAL MAGNETIC FIELD ON THE ION COMPONENT OF PLASMA IN TOKAMAKS. Petrov, M. P. (Ioffe Inst. of Physics and Tech., Leningrad). pp 43-51 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975). (In Russian).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

Experimental measurements are reported of the distribution of charge-exchange atom streaming across the plasma column cross-section in the Tokamak-3, Tokamak-4 and Tokamak-6 devices. They demonstrate that the observed asymmetry in the distribution of high energy atoms ($E \gtrsim 1$ keV) is evidently associated with the drift of ions trapped in the corrugations of the longitudinal field in the tokamaks. By comparison of experimental and theoretical data it is shown that, in tokamaks with a relative field corrugation $\delta \gtrsim 1\%$ (averaged over the plasma column section), the ions trapped in the corrugations (so-called locally trapped ions) entrain an appreciable fraction of the energy from the ion component of the plasma. (auth)

5329 RELAXATION OF TOROIDAL DISCHARGES TO STABLE STATES AND GENERATION OF REVERSE MAGNETIC FIELDS. Taylor, J. B. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 161-167 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

A striking feature of toroidal discharges is the appearance of a quiescent state in which, if the pinch ratio θ is large, there is a reversed toroidal magnetic field. It is shown that this remarkable behavior is the result of plasma relaxation under topological constraints. For a perfectly conducting plasma there is an infinity of such constraints, essentially one for each field line. When all these are taken into account the final state may be any equilibrium. However, in the presence of small departures from perfect conductivity, lines of force may break and only one constraint remains. The final state is then a unique, stable configuration depending only on the pinch ratio θ. The critical value of θ for the onset of reversed field in this unique state agrees well with measurements on ZETA. When θ exceeds a second critical value, the final state becomes helically deformed and the onset and amplitude of this deformation are calculated. When the TOKAMAK regime is examined it is found that the relaxed state exhibits a marked qualitative difference in field structure according as $q \lesseqgtr$ unity. (auth)

5330 WELL-CENTERED DISCHARGES IN THE PULSATOR-I TOKAMAK. Klueber, O.; Corti, S.; Gernhardt, J.; Karger, F.; Lisitano, G.; Meisel, D.; Sesnic, S. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 179-184 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

The use of programmed vertical magnetic fields in the Pulsator-I facility allows good long-term centering of the plasma column and, therewith, stable, reproducible discharges with q-values down to 2.3. In the case where the vertical-field program is not optimized, the discharge at low q-values is very susceptible to the disruptive instability. The experiments show two different forms of this instability, a "hard" and a "soft" type one; these are clearly governed by the position of the plasma column before the onset of the instability, i.e. whether it is displaced inwards or outwards, respectively. The difference is explained in semiphenomenological terms by using the equilibrium diagram. Both types can be selectively triggered in an arbitrary way by displacing an otherwise well-centered plasma column. (auth)

5331 INFLUENCE OF RESONANT HELICAL FIELDS ON TOKAMAK DISCHARGES. Karger, F.; Wobig, H.; Corti, S.; Gernhardt, J.; Klueber, O.; Lisitano, G.; McCormick, K.; Meisel, D.; Sesnic, S. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 207-213 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

The resonant interaction of external helical $l = 2$ fields with the $q = 2$ surface and the $m = 2$ modes of a tokamak discharge is studied, information on the disruptive instability and its stabilization is gained, and possible applications of this new resonant-helical-field (RHD) method are mentioned. (auth)

5332 TOKAMAK-DIVERTOR EXPERIMENT IN THE DC OCTOPOLE. Prater, R.; Freeman, R. L.; Hamada, Y.; Moeller, C.; Ohkawa, T.; Tamano, T. (General Atomic Co., San Diego, CA). pp 291-296 of Plasma physics and controlled nuclear fusion research, 1974. Vol. 1. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 1); CONF-741105-P1.

An Ohmic current has been inductively driven in the dc Octopole. The resulting flux configuration resembles that of a tokamak with axisymmetric divertors. The peak current is 4 kA in a toroidal field of 450 G, the density on the axis is 4×10^{11} cm^{-3} and the conductivity electron temperature is 27 eV. Because the plasma energy density is low, magnetic probes can be inserted into the plasma for measurements of the plasma current distribution. Magnetic probe traces that are quiet and reproducible at all positions indicate that the plasma has obtained a stable equilibrium. The initial stage of the discharge is very sensitive to error magnetic fields. Plasma current grows until a current disruptive instability occurs, which reduces the peak current density by 40 percent. At the time of the instability the safety factor q at the axis is

estimated to be q(0) approximately 0.8, while the q equals 1 surface is located at the edge of current distribution. The effect of the instability is to redistribute current density from the center of the distribution to the wings. The disruptive instability is characterized by mode numbers m equals 0, n equals 0, but it is usually preceded by amplitude saturated fluctuations with m equals 2, n equals 1 that are peaked on the q equals 2 surface. (auth)

5333 TWO-DIMENSIONAL SIMULATION OF A FLUID MODEL FOR TOKAMAK. Tuttle, G. H.; Potter, D. E.; Haines, M. G. (Imperial Coll. of Science and Tech., London). pp 697-710 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

This paper describes a two-dimensional time-dependent numerical model of a tokamak plasma configuration employing classical one-fluid equations. The code, named TICTOK, employs a Lagrangian mesh in the poloidal plane based on the contours of the toroidal magnetic vector potential (or magnetic flux surfaces). A time-varying orthogonal mesh is generated, and it is possible to use an arbitrary toroidal aspect ratio or cross-section. By means of a lowest order condition on the flow that can be described as toroidal incompressibility, the fast toroidal Alfvén wave can be removed, and the model structured to follow the slower poloidal Alfvén and acoustic time scales and the resistive time scale. Two regimes of operation are described. First, a hot equilibrium state is followed, showing the onset of $m \geq 1$ oscillating vortex cells associated with poloidal Alfvén waves (symmetric above and below the mid-plane). The oscillatory flow is typically 10^4 times the residual time-averaged Pfirsch-Schlüter resistive flow. Second, the early stages of the discharge are followed, showing that there is a concentration of toroidal current near the inside wall of the torus owing to the larger value of the induced electric field $-\partial A_\phi/\partial t$ in this region. Correspondingly, the Ohmic heating in this region increases the conductivity and current in this region while near the outside wall of the torus the low conductivity permits a more rapid diffusion of the field. (auth)

5334 CLEO STELLARATOR. Reynolds, P.; Millward, P.; Hunt, R. R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 13-19 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

A brief description of the Cleo stellarator, the aims of the experiment and very preliminary results for the plasma characteristics are given. (auth)

5335 THERMAL ISOLATION AND CONFINEMENT OF PLASMA IN THE "URAGAN" ("HURRICANE") STELLARATOR. Dikii, A. G.; Kuznetsov, Yu. K.; Pavlicheko, O. S.; Pashnev, V. K.; Perepelkin, H. F.; Suprunenko, V. A.; Tolok, V. T. (Physical-Technical Inst., Kharkov). pp 45-61 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna, International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol 2); CONF-741105-P2.

Experiments were completed on the three-turn stellarator-racetrack "Uragan-1" ("Hurricane-1") (a = 10 cm, R = 110 cm, $\bar{t}(a) \simeq 0.8$, $H_0 \leq 10$ kOe) at the Institute of Physics and Technology of the Academy of Sciences of the Ukraine (Kharkov). The current and high-frequency methods for heating plasma were investigated in experiments conducted on the U-1 stellarator. In both instances an effort was made to obtain a plasma with parameters close to the limits for the given apparatus. With the plasma density $n = (1-8) \times 10^{12}$ cm^{-3}, the electron temperature in the case of current heating reached $T_e \leq 400$ eV (ion temperature $T_i \leq 30$ eV), and the ion temperature reached $T_i \leq 500$ eV (electron temperature $T_e \leq 50$ eV) using high-frequency techniques. In both cases the maximum value of the parameter $\beta = 8\pi nT/H_0^2$ was $\simeq 10^{-3}$, and the experimental conditions basically corresponded to the "plateau" regime in terms of neoclassical theory. Equilibrium of the plasma column, its stability (over a broad frequency range), and the behavior of the coefficients of thermal conductivity and diffusion were investigated. The experiments which were conducted, along with theoretical evaluations, showed the absence of noticeable effects of disruption of plasma equilibrium under both conditions of current and HF heating. Strong instabilities, which determined the character of the main macroscopic parameters, were inherent in the current plasma: a strong anomaly in the thermal conductivity of the electrons and the diffusion of particles (form the standpoint of neoclassical theory), and also an anomaly in the electrical conductivity of the plasma. In the plasma created using the HF method, the fluctuation level was significantly lower, and, in accordance with this, the measured rates of heat loss and charged-particle loss proved to be close to those predicted by theory. Now, new helical windings permitting work with a magnetic field of up to 25 kOe have been installed; in future experiments, this apparatus will be called the "Uragan-2". (auth)

5336 STELLATRON: A MAGNETIC SYSTEM FOR CONTAINMENT OF CURRENT-FREE PLASMA WITH IMPROVED TOROIDAL EQUILIBRIUM. Danilkin, I. S.; Kovrizhnykh, L. M. (Lebedev Inst. of Physics, Moscow). pp 163-175 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Problems of the creation of a "stellatron"-type of containment configuration—a stellarator magnetic trap with a noncircular, elliptical cross-section of magnetic surfaces with a highly eccentric position—are discussed. Evaluations are made which show that in intermediate and hydrodynamic collision frequency regions the coefficients of diffusion and thermal conductivity in a stellatron can amount to a value of the order of a^2/b^2 of the corresponding coefficients of toroidal systems with a circular cross-section (here, a is the minor and b the major semi-axis of the elliptical cross-section of a toroidal configuration). Examples of possible current systems capable of providing the required magnetic-field configuration are given. (auth)

5337 RADIATION DAMAGE BY NEUTRONS TO MATERIALS IN DT FUSION REACTORS. Kulcinski, G. L. (Univ. of Wisconsin, Madison). pp 251-273 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

A review of the effects of DT neutron damage in fusion reactor structural components and magnets is given. It is shown that the displacement rates in fusion systems are about equal to or less than those of present-day fission reactor facilities but gas production rates are one to two orders of magnitude higher. The effect of neutrons on mechanical properties such as yield strength, ductility, and creep is briefly reviewed and it is noted that very little, if any, direct data exist for 14-MeV-neutron-irradiated metals. Resistivity increases in magnet-stabilizing metals and the reduction in critical properties of superconductors is shown to be minimal and subject to reduction by several design options. The level and decay of induced radioactivity is explored for various metals and levels of greater than or equal to 1 Ci per thermal watt are easily achieved at shutdown. The decay of afterheat, from shutdown values of 0.5 to 1 percent of the operating power, is shown to be a function of materials choice and V and Al appear to offer some distinct advantages. Finally, a possible method of solving radiation damage problems is discussed. (auth)

5338 SILICON CARBIDE AND GRAPHITE MATERIALS FOR FUSION REACTORS. Hopkins, G. R. (General Atomic Co., San Diego, CA). pp 275-285 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

The utilization of low-atomic-number materials for first-wall and blanket structural materials for fusion reactors and devices is proposed. The low-atomic-number (Z) materials are important to consider for minimizing radiation losses from plasma impurities (the losses may have a Z^4-dependence) and could be advantageous in present-day confinement devices as well as fusion power reactors. Silicon carbide, carbon materials, and mixtures appear as prime candidates. Advantages accruable in a fusion power reactor are 1) very low induced radioactivities for reduction of waste disposal and operational problems, 2) high-temperature operation (greater than 1000°C) for high efficiency and low waste heat, and 3) abundant and inexpensive raw-material supply. Material properties appear reasonably well suited for fusion-reactor application and a technology base is available from a High-Temperature Gas-Cooled Reactor (fission) as well as many other applications. Significant problem areas for further

study are the effects of transmutation products from (n, alpha) and (n, p) reactions in the materials, and design and fabrication problems for relatively large, high-integrity structures with these ceramic, non-ductile materials. (auth)

5339 PLASMA CONTAMINATION AND WALL EROSION IN CONTROLLED THERMONUCLEAR FUSION DEVICES AND REACTORS. Kaminsky, M. S. (Argonne National Lab., IL). pp 287-299 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

During the operation of thermonuclear devices and reactors, the surfaces of such major components as container walls, beam limiters, diverter walls, and beam-dump walls of the injector region will be exposed both to the primary plasma radiations and to secondary radiations from (n, gamma), (n,p), (n, alpha), and other nuclear reactions and from various secondary particle- and photon-emission phenomena induced by the primary radiation. Such energetic radiations striking the surfaces of components of fusion devices and reactors can cause a variety of surface phenomena and thereby (a) the release of major quantities of gas which will contaminate the plasma, and (b) the damage and erosion of the bombarded wall. A summary of recent experimental results on plasma contamination and wall erosion due to radiation blistering and the release of particulate matter from solids under irradiations induced by 14-MeV neutrons will be presented. (auth)

5340 START-UP AND ASSOCIATED WALL PROBLEMS IN TOROIDAL FUSION REACTORS. Bodin, H. A. B.; McCracken, G. M. (EURATOM-UKAEA, Abingdon, Eng.). pp 303-311 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Based on reports of the study groups on reactor start-up and first-wall problems at the IAEA Workshop on Fusion Reactor Design Problems held at Culham in January/February 1974, but enriched with new material on first-wall surface problems, the paper gives a brief account of the general problems of starting up a thermonuclear reactor. The significance of losses is emphasized, e.g. turbulent energy losses during current rise in tokamaks and reverse-field pinches. The effect of these losses on the first wall is discussed. (auth)

5341 EXPERIMENTAL STUDY OF LASER-DRIVEN COMPRESSION OF SPHERICAL GLASS SHELLS. Charatis, G.; Downward, J.; Goforth, R. (KMS Fusion, Inc., Ann Arbor, MI). pp 317-333 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

Laser-driven compression, core heating, and neutron generation are experimentally observed when DT-filled glass shells are illuminated by intense laser radiation. Requirements for obtaining strong compressions and neutron generation include nearly uniform illumination, energies on-target greater than 0.7 J per nanogram of shell mass, symmetric target disassembly and on-target intensities of 10^{15}W/cm^2. The laser system, target illumination optics, targets, and laser target diagnostics are described in detail. (auth)

5342 STUDY OF THE FOCUSING OF HIGH-CURRENT BEAMS FOR HEATING AND COMPRESSION OF A DENSE D-T PLASMA. Koba, Yu. V.; Liksonov, V. I.; Pen'kina, V. S.; Rudakov, L. I.; Sidorov, Yu. L.; Smirnov, V. P.; Sukhov, A. D.; Tarumov, E. E. (Inst. of Atomic Energy, Moscow). pp 337-345 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The paper presents the results of an experimental study on the focusing of electron beams with $v/\gamma \gg 1$ in the Triton and Ural devices. The focusing took place in diodes, use having been made of a plasma channel on the axis of the accelerator gap. The channel was formed by means of conical and pin-type cathodes. Focused beams were obtained with a duration of $\simeq 30-40$ ns with a current density of up to 30 MA/cm^2, the electron energy having been as much as 600 keV at a full current of up to 200 kA and a beam energy of up to 2 kJ. The dependence of focusing on the magnitude of the accelerator gap was studied and its optimum value determined. Results are given for experiments on the focused-beam heating of an aluminium-foil target of a special form. On homogeneous irradiation of the target, it was found that cumulative jets with 0.8 mm transverse dimension were formed. The rate of expansion of material was 1×10^6 cm/s, which corresponds to an energy contribution of $\simeq 10$ eV per atom of the target material. (auth)

5343 FUSION INDUCED BY RELATIVISTIC ELECTRON BEAMS. Chang, J.; Clauser, M. J.; Freeman, J. R. (Sandia Labs., Albuquerque, NM). pp 347-354 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

Recent progress in the Sandia REB Fusion Program is reviewed including theoretical and experimental results on focusing, deposition, and pellet implosion. Measurements of time-dependent pinching of the beam are compared with numerical models including diode plasmas. The self-field of a beam has been included in a beam-deposition model and experiments involving front- and rear-surface diagnostics are presented. Spherical and hemispherical gold shells have been imploded using one and two beams and bremsstrahlung output as well as separate flash radiographs are given. Short-pulse accelerator technology requirements and developments are discussed and an example of a typical pellet design calculation is shown. (auth)

5344 LASER-PLASMA INTERACTION AND HYDRODYNAMIC BEHAVIOR OF LASER-IRRADIATED PLANE TARGETS. Eidmann, K.; van Kessel, C.; Key, M. H.; Mulser, P.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 357-364 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Mutually interfering measurements were carried out in a plasma created with a single beam of a 50 J/5 ns Nd-laser and with plane solid targets of deuterium, hydrogen and other materials. The electron density and temperature in the plasma were measured by time- and space-resolving x-ray diagnostics. Direct observation of the laser-driven shock wave in the solid by high-speed photography gave quantitative values of the pressure and the compression ratio. The backscatter of laser light was studied in detail. A reflection coefficient increasing with intensity up to 30% was found independently of the target material. Different types of interaction were identified by studying the angular distribution and polarization properties of the backscattered fundamental and second-harmonic light. The results are discussed with respect to their relevance to laser fusion. (auth)

5345 EXPERIMENTAL STUDIES ON THE INTERACTION OF LASER RADIATION WITH PLASMA IN MISHEN-1 AND MISHEN-2 DEVICES. Alekhsandrov, V. V. (Inst. of Atomic Energy, Moscow); Borzenko, V. L.; Burdonskii, I. N. pp 365-373 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The paper describes the optical circuit of the laser system of the Mishen-2 device on neodymium glass. With this circuit it is possible to obtain an energy of ~1 kJ in a time-shaped laser pulse. Powerful amplifier stages with active elements of rectangular cross-section were used at the output of the system. The construction of the interaction chamber is described. It includes a focusing system, a target unit and elements of diagnostic apparatus. The paper discusses the results of prognostic numerical experiments demonstrating the possibility of attaining an ~100-fold compression of solid target material in a unidimensional plane geometry. The experimental data obtained in the Mishen-2 device are compared with theoretical models. The spectra of scattered radiation were studied in the Mishen-1 device with an energy of up to 100 kJ in a short pulse of nanosecond duration. Experimental data obtained by various means of observation are compared. The possible mechanisms of nonlinear interaction between a laser beam and a high-density high-temperature plasma are discussed. (auth)

5346 LASER-PLASMA EXPERIMENTS RELEVANT TO LASER-PRODUCED IMPLOSIONS. Ahlstrom, H. G.; Holzrichter,

J. F.; Manes, K. R.; Coleman, L. W.; Speck, D. R.; Haas, R. A.; Shay, H. D. (Univ. of California, Livermore). pp 375-404 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Preliminary laser-target interaction studies designed to provide code normalization data in a regime of interest to laser fusion are reported. The laser facilities constructed for such studies, the target diagnostic systems, and preliminary experimental results are described. (auth)

5347 LIGHT ABSORPTION AND ENERGY BALANCE AT THE SURFACE OF A LASER-IRRADIATED SOLID TARGET. Galanti, M.; Peacock, N. J.; Norton, B. A.; Puric, J. (EURATOM-UKAEA, Abingdon, Eng.). pp 405-419 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Spatially-resolved values of the parameters of plasma produced by laser-irradiation of a plane, polyethylene surface, have been deduced from analyses of the soft x-ray spectrum. The density, temperature and the thermodynamic state of the free and bound electrons are derived from absolute intensity measurements of the recombination continuum of ^{6+}C and ^{5+}C and from the intensity and spectral shapes of the ^{5+}C emission lines. The various derivations of the electron density give self-consistent results for the density profiles in the region of the plasma where the laser light is absorbed. With a light flux density $\varphi_0 \lesssim 10^{12}$ W · cm^{-2} on the target, the electron energy distribution at the reflection point is Maxwellian and the ion populations are determined by collisional radiative processes in a thin plasma layer of the order of 1 μm width. A one-dimensional model for the light/plasma interaction (MEDUSA), in which there is classical resistive absorption of the incident light, is in fair agreement with the experimental observations. Above 10^{12} W · cm^{-2}, a two-component Maxwellian electron distribution is observed and a rapid increase in the back-scattered second harmonic of the incident light indicates the onset of anomalous absorption. A consideration of energy balance shows that most of the input energy can be accounted for by ion expansion and by radiation losses from 'opacity-broadened' resonance lines of the carbon ions. (auth)

5348 THERMONUCLEAR FUSION PLASMA PRODUCED BY LASERS. Yamanaka, C. (Osaka Univ.); Yokoyama, M.; Nakai, S. pp 421-434 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Recently, much attention has been focused on laser fusion schemes using high-density plasmas produced by implosion. Scientific-feasibility laser-fusion experiments are now in time. But the physics of interaction between laser and plasma, the high-compression technique and the development of high-power lasers are still important problems to be solved if laser fusion is to make some progress. In the field of laser-plasma coupling, experiments were carried out in which hydrogen and deuterium sticks were bombarded by laser beams; in these experiments, a glass-laser system, LETKKO-I, with an energy of 50 J in a nanosecond pulse, and a double-discharge TEA CO_2 laser system with an energy of 100 J in a 100-ns pulse were used. A decrease in reflectivity occurred at a laser intensity one order of magnitude higher than the parametric-instability threshold. Self-phase modulation of scattered light due to modulational instability was found. A Brillouin-backscattering isotope effect due to the hydrogen and deuterium plasma has also been observed in the red-side part of the SHG-light. Preliminary compression experiments have been carried out using a glass-laser system LETKKO-II, with an energy of 250-1000 J in a ns-pulse. A hologram has been used to study shock waves in the plasma due to the SHG-light converted from the main laser beam. Development of high-power lasers has been promoted, such as disc-glass lasers, E-beam CO_2 lasers and excimer lasers. (auth)

5349 INTERACTION OF A CO_2 LASER BEAM WITH A DENSE PLASMA. Fabre, E.; Popovics, C.; Stenz, C.; Virmont, J. (Ecole Polytechnique, Paris). pp 435-446 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The interaction of a CO_2 laser beam with a high-density plasma and a solid target is investigated. In both experiments, above certain laser intensities, it seems necessary to seek absorption mechanisms other than inverse bremsstrahlung to interpret the results obtained for plasma absorption or the reflection coefficient of the targets. In the experiments with a target, the second harmonic is observed and its origin is definitely not due to an instability. The hard x-radiation observed, which on average corresponds to a superthermal component between 1.2 and 1.6 keV, is also subject to very large random variations in intensity under optimum focusing conditions of around 10^{12} W/cm^2. (auth)

5350 EXPERIMENTAL STUDY OF THE SHOCK WAVE GENERATED IN A HOLLOW CYLINDRICAL TARGET BY SEVERAL LASER BEAMS. Schirmann, D.; Billon, D.; Cognard, D.; Launspach, J.; Patou, C. (Centre d'etudes de Limeil, Villeneuve-Saint-George, France). pp 449-457 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In French)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

This experiment on the irradiation of a hollow cylindrical target with several laser beams is a preliminary to a program of experiments on the implosion of targets by lasers. The aim of this experiment is to observe the fundamental phenomena accompanying the creation and propagation of a centripetal shock wave generated by laser beams. In particular, the geometry of the target was selected so as to facilitate observation of the propagation of the shock wave close to its axis. After describing the experimental device, the authors present the results of a study of plasma ablation on the outside of the target and of the propagation towards the axis of the wave generated on the inside of the target. The role played by thermal conduction in smoothing defects in the uniformity of illumination is demonstrated and it is shown that under certain laser beam focusing conditions it is possible to obtain plasma ablation with rotational symmetry. The authors measure the transit time of the shock wave in the wall and its focusing time as a function of the wall thickness and the external diameter of the target. The pressure and density in the centripetal shock generated by plasma ablation is estimated from the wave velocity using the dynamic adiabat of the material. The pressure generated attains 1 Mbar for a laser illumination of 3 x 10^{13} W/cm^2. (auth)

5351 SINGLE- AND MULTI-BEAM LASER PELLET FUSION EXPERIMENTS. Lubin, M.; Goldman, E.; Soures, J.; Goldman, L.; Friedman, W.; Letzring, S.; Albritton, J.; Koch, P.; Yaakobi, B. (Univ. of Rochester, NY). pp 459-477 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

Absorption, reflection, and symmetry measurements have been made on spherical laser fusion targets for both single beam (highly non-symmetric), and four beam (more symmetric) irradiation, at incident laser energies of up to 250 J. Optical, charged particle and x-ray measurement techniques are used to show the essentially symmetric behavior of the multi-beam irradiation. A measure of the effectiveness of lateral heat conductivity is obtained from a comparison of symmetric and non-symmetric irradiation results. Greater than 30% of the incident laser energy at an intensity of $10^{15}-10^{16}$W/cm^2 results in elevated plasma temperatures. The energy deposited in high energy photons is less than 10^{-1} of the absorbed energy. No distinct high energy ion component is observed and, in any case, less than a few percent of the absorbed energy resides in ions of energies > 10 keV/nucleon. Time-resolved optical diagnostics have uncovered the presence of an "after pulse" emitted from the plasma at the laser frequency but following the trailing edge of the heating pulse. (auth)

5352 LASER-PLASMA STUDIES OF SOLID PELLETS IRRADIATED WITH THE SANDIA FOUR-BEAM LASER. Powell, J. E.; Beckner, E. H.; Brannon, P. J.; Cano, G. L.; Cuderman, J. F.; Gilbert, K. M.; Palmer, M. A. (Sandia Labs., Albuquerque, NM). pp 487-493 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Experiments are under way at Sandia Laboratories in which spherical CD_2 and LiD pellets are being irradiated in a tetra-

hedral geometry with four beams of up to 50 J/beam from a Nd:glass laser. Pellets ranging in diameter from 50 to 200 mu m have been irradiated with pulses of width 0.97 ns. Of the laser output energy, approximately 35 to 40 percent is absorbed by the target. Most of this energy manifests itself in kinetic energy of the ions. X-ray spectra show simple bremsstrahlung-recombination distributions which indicate electron temperatures in the few hundred eV range. No target neutrons have been observed. CD_2 targets also have been irradiated in a background deuterium gas ranging in pressure from 0.1 to 10 Torr. Neutrons are observed coming from the gas. (auth)

5353 CARBIDE DIOXIDE LASER DEVELOPMENT AND ASYMMETRY IN LASER-DRIVEN IMPLOSIONS. Benjamin, R. F.; Boyer, K.; Farnum, E. H. (Los Alamos Scientific Lab., NM). pp 495-503 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

The short pulse CO_2 laser in operation at Los Alamos was developed to produce a short pulse laser beam for experiments on laser-plasma interactions at 10 μm wavelength and to provide an engineering basis on which larger, more efficient CO_2 lasers can be designed. The laser now generates pulses at 10.6 μm wavelength containing 300 J in 1.5 ns and is presently being upgraded to produce ~ 400-500 J. The beam is of good optical quality and can be focused into a diameter of approximately 140 μm. The peak power at the focus reaches $7 \times 10^{14} W/cm^2$. Asymmetry in laser-driven implosions is also discussed. (auth)

5354 THEORETICAL AND NUMERICAL STUDIES OF ANOMALOUS REFLECTION AND ABSORPTION OF LIGHT IN LASER-IRRADIATED PLASMAS. Biskamp, D.; Welter, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 507-514 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

Parametric processes excited in the plasma corona of a target irradiated with high power laser light are investigated by one- and two-dimensional numerical simulations. Results are reported on (1) the frequency spectrum of the scattered light and the process of dissipation due to stimulated Raman scattering, (2) the angular distribution of Raman and Brillouin scattered light and the absorption coefficient due to $2\omega_{pe}$ decay, particularly for oblique incidence, and (3) the interference between the different processes if they occur simultaneously. Theoretical models are given to explain the numerical results, which are also compared with experimental measurements. (auth)

5355 LASER LIGHT ABSORPTION AND REFLECTION IN PLASMAS. Kruer, W.; Valeo, E.; Estabrook, K.; Thomson, J.; Langdon, B.; Lasinski, B. (Univ of California, Livermore). pp 525-531 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Mechanisms by which intense laser light energy is absorbed or reflected by a hot, dense plasma are of central concern in laser fusion studies. Extensive computer simulations show that the plasma waves responsible for absorption near the critical density are produced by instabilities, resonant excitation and, more generally, by off-resonant coupling by nonlinearly produced ion density fluctuations. Nonlinear modifications in the plasma density profile are found to play a key role in the light absorption. DC magnetic fields large enough to affect electron transport are observed in computer simulations of intense obliquely incident light, even in the absence of irradiation asymmetry. Finally, plasma heating near one-fourth the critical density and the role of bandwidth as a means to control Brillouin reflection are discussed. (auth)

5356 LASER-DRIVEN IMPLOSION OF HOLLOW PELLETS. Nuckolls, J.; Lindl, J.; Mead, W.; Thiessen, A.; Wood, L.; Zimmerman, G. (Univ. of California, Livermore). pp 535-542 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Implosion of hollow (rather than solid) pellets makes possible order of magnitude reductions in the required laser power and significant reductions in the required laser frequency. However, the symmetry and fluid instability problems are more severe in hollow pellet implosions. These problems have been calculated with the LASNEX two-dimensional multi-group energy transport magnetohydrodynamic computer program. Calculations show that laser-driven implosions of moderately hollow pellets to the super-dense Fermi degenerate states required for fusion power production are feasible when the laser power history is tailored to generate an optimum sequence of 5 to 10 weak shocks, the pellet is fabricated with a surface finish accurate to 10 to 100 A and conditions previously described for solid pellets involving the laser wavelength and the initial atmosphere are satisfied. Excessive growth of fluid instabilities destroys implosions of thin-walled hollow pellets driven by smoothly varying pulse shapes otherwise capable of generating the required isentropic high-density states, because the mean acceleration of the imploding shell is too small and because the ablation rate is not large enough to provide effective ablative stabilization. Calculations have also been made of laser-driven implosions of complex hollow pellets containing one or more shells of high-density, high-Z materials (e.g., Fe or U). These pellets do not have high enough gain for laser fusion power production unless the laser efficiency is much greater than 10 percent or unless the reactor is a hybrid (fission-fusion). (auth)

5357 IMPLOSION, STABILITY, AND BURN OF MULTI-SHELL FUSION PELLETS. Fraley, G. S.; Gula, W. P.; Henderson, D. B.; McCrory, R. L.; Malone, R. C.; Mason, R. J.; Morse, R. L. (Los Alamos Scientific Lab., NM). pp 543-555 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Various multi-shell laser/e-beam fusion pellets are described. These include a design with hollow fuel inside a high-Z pusher shell which gives greatly improved performance without extreme pulse shaping. The advantages of multi-shell, multi-material pellets are discussed in general. Stability calculations then show that Taylor instability on both the inside and outside of the shells can amplify perturbations with spherical harmonic l-numbers of the order of 100 by factors exceeding ten thousand. However, by decreasing the shell aspect ratios (r/DELTAr) and intensifying the ablation rate, these amplifications can be greatly reduced. Acceptable instability growth seems attainable by using aspect ratios of the order of five or less and/or by operating in a less efficient exploding pusher mode. The effects of tamping by high-Z material on thermonuclear burn are briefly discussed. (auth)

5358 THERMONUCLEAR LASER TARGETS WITH LARGE ENERGY GAIN COEFFICIENTS. Afanas'ev, Yu. V.; Basov, N. G.; Volosevich, P. P. pp 559-563 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

The authors consider one variant of thermonuclear laser targets, based on the principle of compression with weak sensitivity to the shape of the laser pulse, containing a relatively large mass of nuclear fuel and possessing a large energy gain coefficient ($\gtrsim 100$). Examples of numerical calculations of compression and combustion hydrodynamics are given for an energy range of 10^4 to 10^6 J. (auth)

5359 CONTROLLED FUSION BY IMPLODING LINER FLUX COMPRESSION. Barcilon, A. I.; Book, D. L.; Boris, J. P. (Naval Research Lab., Washington, DC). pp 567-576 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

The application of imploding liner flux compression techniques to the compression of plasma in simple, axially symmetric confinement geometries leads, at least in principle, to the possibility of very compact fusion reactors. Scaling laws are derived for liner-plasma systems in straight θ-pinch, spindle-cusp and cusp-ended θ-pinch configurations. Results are presented from two-dimensional computations of liners imploding on a cusp plasma. Stabilization of the inside surface of the liner against Raleigh-Taylor instabilities can be achieved by rotation of a liquid liner. Coupled with electromagnetic compression systems, this should lead to reversible, non-destructive compression-expansion cy-

cles reaching megagauss fields and plasma densities ~ 10^{19} cm^{-3} at peak compression. The most promising configuration for a reactor appears to be the θ-pinch with cusp ends. (auth)

5360 EFFECTIVENESS OF A THERMONUCLEAR SYSTEM OF θ PINCH AND LINER TYPE. Alikanov, S. G.; Konkashaev, I. K. (Inst. of Atomic Energy, Moscow). pp 577-584 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975). . (In Russian)

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol. 2); CONF-741105-P2.

The authors consider the effect of compressibility of the liner material on the effectiveness of the θ pinch and liner system. They make numerical calculations for the compression dynamics of the liner, the results of which are represented by approximate expressions. (auth)

5361 EXPERIMENTS ON STRONG ELECTROMAGNETIC INTERACTIONS WITH PLASMAS: INVESTIGATION OF NON-LINEAR PROCESSES IN LASER FUSION. Wong, A. Y. (TRW Systems, Los Angeles); Stenzel, R. L.; Kim, H. C.; Chen, F. F. pp 589-597 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The large resonant response of a nonuniform plasma to an incident electromagnetic wave in the critical region $\omega_p(x_c) \approx \omega_0$ has resulted in strong non-linearities. Ponderomotive forces drive electrons and ions out from the resonant region, creating density perturbations as large as 60%. Accelerated ions gain energy by as much as $7kT_e$, while fast electrons gain energy by as much as 25 kT_e through transit-time damping. Parametric backscattering has also been observed with CO_2 radiation in a plasma well below the critical density. The threshold agrees in order of magnitude with the theory of simulated Billouin scattering in a finite region. (auth)

5362 GAS-BLANKET STUDIES IN TOROIDAL ARCS. Schueller, F. C.; De Hass, R. S.; Brandt, B.; Schrader, W. J.; Ornstein, L. T. M.; Braams, C. M. (EURATOM-FOM, Jutphaas, Netherlands). pp 725-738 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Magnetized arc discharges are used to gather information on transport phenomena in the partially ionized transition layer between a neutral gas blanket and a fully ionized hot plasma core. The conditions can be made similar to those that might prevail in the outer layers of a steady-state thermonuclear reactor in which fuelling and helium removal are maintained by diffusion. To study the influence of toroidicity on transport processes, discharges are made in tokamak-like devices, operated at filling densities between 10^{20} and 10^{22} m^{-3}. In a first experiment the arc was struck between two disk electrodes placed $3\pi/2$ radians apart in a toroidal magnetic field of 2 T with discharge currents up to 32 kA. Electron densities between 10^{21} and $10^{22} m^{-3}$ were measured with temperatures up to 5 eV. Since the spring of 1974, the fully toroidal experiment "Ringboog" with the dimensions R = 0.52 m, a = 0.08 m, B = 3.2 T became operational. Preliminary results have been obtained at lower power. The confinement is predominantly diamagnetic, leading to β_p-values up to 4. If no appropriate vertical magnetic field B_V is used for achieving toroidal equilibrium, a double-vortex flow develops which drives a vertical current limiting the flow velocity, provided that an external conductor is in contact with the plasma. Even in the case of toroidal equilibrium obtained by a proper B_V, a double-vortex convection flow exists. This flow may be identical with the Pfirsch-Schlüter convection. The analysis of the conductivity temperature profile indicates losses by classical ion heat conductivity, with the toroidal correction factor $(1 + 1.6\ q^2)$ included. (auth)

5363 ENGINEERING CONCEPTS FOR LASER-FUSION REACTOR APPLICATIONS. Booth, L. A.; Frank, T. G.; Finch, F. T. (Los Alamos Scientific Lab., NM). Contract W-7405-eng-36. pp 314-319 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The long-range goal of the ERDA Laser Fusion Program is the production of commercial electric power. Although the scientific feasibility of significant thermonuclear energy release from laser-imploded and -heated pellets remains to be demonstrated, significant progress has been made, and many technological problems associated with ultimate applications of laser fusion are being investigated. Preliminary evaluations of several laser fusion reactor concepts have been made, and the most promising concepts, employing different methods for protecting structural components from damage by the products of fusion-pellet microexplosions, are being studied in detail. Engineering design and feasibility studies of other electric generating station subsystems are also under way. Continuing overall economic and technology tradeoff studies assess the economic pontential of various generating station concepts and provide guidance for research and development programs. (auth)

5364 THERMAL POWER CONVERSION SYSTEMS FOR FUSION PLANTS. Sager, P. H. Jr. (General Atomic Co., San Diego, CA). pp 320-328 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The type of power conversion system is dependent upon the coolant used in the fusion reactor. For a direct coolant system where coolant is also used as a fertile material for breeding tritium, lithium and flibe ($LiF-BeF_2$) appear to be suitable. For indirect coolants where the coolant is circulated through the blanket material, lithium, boiling sodium, and helium appear to be the most attractive candidates. Among the power conversion systems, the steam turbine, gas turbine, gas turbine-ammonia binary cycle, potassium-steam binary cycle and potassium-diphenyl-steam ternary cycle systems used with various primary and intermediate coolant loops appear to offer the most promise. (auth)

5365 BIRTH OF EXPERIMENTAL DEVICE VI FOR THE RESEARCH OF CONTROLLED THERMONUCLEAR FUSION. Wu-li; 4: No. 1, 5-8(Feb 1975). (In Chinese)

A description of the tokamak-type device is given. The major radius of its copper shell is 45 cm and the minor radius is 17.5 cm. A photograph of the installation is given. (JPRS)

5366 FUSION CHAIN REACTION: A CHAIN REACTION WITH CHARGED PARTICLES. Peres, A. (Israel Inst. of Tech., Haifa); Sharts, D. Nucl. Fusion; 15: No. 4, 687-692(Aug 1975).

When a DT-plasma is compressed to very high density, the particles resulting from nuclear reactions give their energy mostly to D and T ions, by nuclear collisions, rather than to electrons as usual. Fusion can thus proceed as a chain reaction, without the need of thermonuclear temperatures. Relations are derived for the suprathermal ion population created by a fusion reaction. Numerical integration of these equations shows that a chain reaction can proceed in a cold infinite DT-plasma at densities above 8.4×10^{27} ions $\cdot$ cm^{-3}. Seeding the plasma with a small amount of ^6Li reduces the critical density to 7.2×10^{27} ions $\cdot$ cm^{-3}. (140,000 times the normal solid density). (auth)

5367 COST SCALING OF TOKAMAKS. Sheffield, J.; Gibson, A. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 15: No. 4, 677-685(Aug 1975).

A discussion is given of a method by which simple empirical cost formulas may be combined with technological and physical constraints to establish the parameter region of the optimum (i.e. cheapest) machine design, that will meet given experimental objectives. As an illustration of this cost optimization procedure, the technique is applied to the optimization of a 3 MA tokamak. (auth)

5368 MAGNETIC SHIELDING EFFECT OF A REFUELLING PELLET. Chang, C. T. (Danish Atomic Energy Research Establishment, Risoe). Nucl. Fusion; 15: No. 4, 595-604(Aug 1975).

The magnetic shielding effect of a refuelling pellet is considered by first briefly reviewing the existing balloon model. The limitation of the model is pointed out and discussed. Since solid deuterium is an insulator and the ablated plasma is expected to be cold and dense, it is felt that the existence of a field-free balloon is questionable; rather some field will be trapped by the pellet. On the assumption that the flow of the ablated plasma is governed by a flexible magnetic nozzle, it is shown that the reduction of the ablation rate of the pellet is not due to the exclusion of the field by a balloon, but to the reduction of the ablated plasma pressure through the trapping of the field inside the nozzle. The model also indicates that the penetration of a mm-size pellet into the center of a low-β reactor might be possible, provided an injection speed around 10^4 $m \cdot s^{-1}$ can be attained and no appreciable deceleration process is present. (auth)

5369 PLASMA-WALL INTERACTION THROUGH RIPPLE CONVECTION IN TOROIDAL DEVICES. Englemann, F.; Sestero, A. (Centro Gas Ionizzati, Frascati, Italy). Nucl. Fusion; 15: No. 4, 714-716(Aug 1975).

It is well known that deviations from axisymmetry in toroidal devices lead to the formation of loss cones. As a consequence, a certain number of charged particles can reach the chamber walls, in spite of the presence of a limiter. A strong, localized plasma-wall interaction may thus occur if a sufficient number of highly energetic particles (electrons, most likely) is present. The situation arising in tokamaks is considered because of the ripple of the toroidal field; the considerations can, however, be readily carried over also to stellarator geometry. (auth)

5370 EFFECT OF LONGITUDINAL-MAGNETIC-FIELD CORRUGATION ON A CONFIGURATION WITH HELICAL MAGNETIC AXIS. Shishkin, A. A. (Physico-Technical Inst., Kharkov). Nucl. Fusion; 15: No. 4, 712-714(Aug 1975).

A magnetic configuration (MC) with a helical magnetic axis (HMA) is considered. The effect of perturbations on a MC with a HMA was considered. The role of perturbations was played by magnetic fields which appeared when the magnetic trap was bent into a torus. Resonance phenomena were shown to take place in the behavior of magnetic lines of force (MLF) near a HMA. The unperturbed magnetic configuration is described in detail. (MOW)

5371 FUSION POWER BY MAGNETIC CONFINEMENT: PLANS AND THE ASSOCIATED NEED FOR NUCLEAR ENGINEERS. Hirsch, R. L.; Beard, D. S. (Energy Research and Development Administration, Washington, DC). Nucl. Technol.; 27: No. 1, 84-91(Sep 1975).

An essential ingredient in the fusion development plan will be the training of appropriate scientific and technical manpower. In examining the need for fusion-trained nuclear engineers, it is projected that an additional 120 to 250 engineers at the MS and PhD levels will be needed between now and 1980. To be most effective, these graduates must not only be trained in the "classic" physical, nuclear, mechanical, and electrical sciences, but they will need specialized training in fusion plasma physics and fusion materials science. To help develop the appropriate educational programs, close cooperation between U. S. Energy Research and Development Administration (ERDA) headquarters, ERDA laboratories, private industry, and the universities will be essential. An emerging need for a carefully structured "fusion technology" option in nuclear engineering departments is plainly evident and is already beginning to be developed at leading institutions. (auth)

5372 FUSION PHYSICS AND ENGINEERING: A PART OF THE NUCLEAR ENGINEERING CURRICULUM. Kammash, T. (Univ. of Michigan, Ann Arbor). Nucl. Technol.; 27: No. 1, 92-95(Sep 1975).

A new breed of nuclear engineers will be needed in the years preceding demonstration of scientific feasibility of controlled thermonuclear reactions (expected in the early 1980's) and for many decades afterwards to help solve the technological problems and to ultimately design, man, and operate fusion power reactors. A comprehensive graduate training program in "fusion science and engineering" for this new breed of engineers is proposed. (auth)

5373 TEACHING AND RESEARCH IN FUSION PLASMAS AND TECHNOLOGY AT THE UNIVERSITY OF ILLINOIS. Miley, G. H.; Southworth, F. H. (Univ. of Illinois, Urbana). Nucl. Technol.; 27: No. 1, 96-106(Sep 1975).

Teaching in fusion at the University of Illinois is an integrated part of the nuclear engineering curriculum. Through the use of two key courses, "Introduction to Fusion" and "Fusion Systems," basic preparation for those wishing to specialize in fusion is provided. These courses are primarily directed to plasma aspects of fusion, but materials and other engineering aspects have been integrated into the curriculum through a broadened coverage in such existing courses as nuclear materials, shielding, and reactor physics. Research is primarily focused at the PhD level, although some MS studies are in progress. While current theses involve a wide variety of topics, one major area being pursued is the study of advanced fuel (non-deuterium-tritium) reactors based on two-component fusion and other concepts. This effort consists of a series of loosely knit subtasks related to such problems as cyclotron emission and direct energy conversion. Also, various research involving charge-exchange losses during neutral-beam injection, vacuum-wall sputtering, and related topics has developed as a direct outgrowth of the PROMETHEUS project, which involved the conceptual design of a power-consuming mirror-type reactor for materials and engineering tests. (auth)

5374 COMPUTER APPLICATIONS IN CONTROLLED FUSION RESEARCH. Killeen, J. (Univ. of California, Davis). Nucl. Technol.; 27: No. 1, 107-113(Sep 1975).

The application of computers to controlled thermonuclear research (CTR) is essential. In the near future the use of computers in the numerical modeling of fusion systems should increase substantially. A recent panel has identified five categories of computational models to study the physics of magnetically confined plasmas. A comparable number of types of models for engineering studies is called for. The development and application of computer codes to implement these models is a vital step in reaching the goal of fusion power. To meet the needs of the fusion program the National CTR Computer Center has been established at the Lawrence Livermore Laboratory. A large central computing facility is linked to smaller computing centers at each of the major CTR Laboratories by a communication network. The crucial element needed for success is trained personnel. The number of people with knowledge of plasma science and engineering trained in numerical methods and computer science must be increased substantially in the next few years. Nuclear engineering departments should encourage students to enter this field and provide the necessary courses and research programs in fusion computing. (auth)

5375 EVALUATION OF FUSION RESEARCH AND INSTRUCTION AT THE UNIVERSITY OF WISCONSIN. Maynard, C. W. (Univ. of Wisconsin, Madison). Nucl. Technol.; 27: No. 1, 114-118(Sep 1975).

The University of Wisconsin fusion research program is divided between plasma physics and fusion reactor technology studies. Both research and teaching are the integrated efforts of several departments, with a substantial number of courses available to both graduate and undergraduate students. The program has been successful in producing students for the national controlled thermonuclear research program. It has also produced significant research results, particularly in the toroidal confinement and conceptual reactor design fields. (auth)

5376 LOW ENERGY X-RAY MICRORADIOGRAPHY OF LASER FUSION TARGETS. Prevender, T. S.; Lynch, A. W. (Sandia Labs., Albuquerque, NM). Mater. Eval.; 33: No. 10, 246-248(Oct 1975).

A low-energy x-ray radiography apparatus was developed primarily for the nondestructive inspection of LiD laser fusion targets. Exposure times of 15 min at 6 keV were found satisfactory for the detection of voids in nominal 100-micron diam spheres. (auth)

5377 ENVIRONMENTAL ASPECTS OF FUSION REACTORS. Coffman, F. E.; Williams, J. M. (Energy Research and Development Administration, Washington, DC). Nucl. Technol.; 27: No. 1, 174-181(Sep 1975).

With the continued depletion of fossil and uranium resources in the coming decades, the U. S. will be forced to look more toward renewable energy resources (e.g., wind, tidal, geothermal, and solar power) and toward such longer-term and nondepletable energy resources as fissile fast breeder reactors and fusion power. Several reference reactor designs have been completed for full-scale fusion power reactors that indicate that the environmental impacts from construction, operation, and eventual decommissioning of fusion reactors will be quite small. The principal environmental impact from fusion reactor operation will be from thermal discharges. Some of the safety and environmental characteristics that make fusion reactors appear attractive include an effectively infinite fuel supply at low cost, inherent incapability for a "nuclear explosion" or a "nuclear runaway," the absence of fission products, the flexibility of selecting low neutron-cross-section structural materials so that emergency core cooling for a loss-of-coolant or other accident will not be necessary, and the absence of special nuclear materials such as ^{233}U or ^{239}Pu, so that diversion of nuclear weapons materials will not be possible and nuclear blackmail will not be a serious concern. (auth)

5378 SUPERCONDUCTING TOROIDAL MAGNETS FOR FUSION FEASIBILITY EXPERIMENTS AND POWER REACTORS. Lubell, M. S. (Oak Ridge National Lab., TN). pp 164-173 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

It has been recognized that large superconducting magnets will have to be developed in order to obtain power economically from a thermonuclear reactor. In the present paper, we offer compelling reasons to illustrate how vital they are even for the sizes envisioned for hydrogen feasibility and D-T burning ex-

periments. Detailed discussion is given on the type of magnets used for the plasma confinement in a tokamak-type machine. Illustrations are given to show that their development is within the present technological progress of superconductivity. The methods used to estimate the cost of such a toroidal system are provided along with how the cost varies with changes in magnet aspect ratio, major radius (varies as $R^{1.95}$), and stored energy (varies as $E^{0.48}$/sub s/). The latter quantity is presented as a valid figure of merit for quickly estimating the cost of any large superconducting toroidal system. (auth)

Wave Phenomena

5379 (COO--3004-11) DEPARTMENT OF PHYSICS ANNUAL PROGRESS REPORT, JUNE 1975. Schmidt, G. (Stevens Inst. of Tech., Hoboken, N. J. (USA)). Jun 1975. Contract AT(11-1)-3004. 10p. (SIT--291). Dep. NTIS $4.50.

A dispersion relation was derived for the interaction of a large amplitude Langmuir wave with ion waves in a uniform plasma. The dispersion relation contains in addition to the well known modulational and resonant backscatter instabilities, a modified oscillating two stream instability, a nonlinear Landau instability (resistive quasi mode) and a reactive quasi mode. It was found that envelope solitons are unstable against perpendicular perturbations and tend to break up into blobs while radiating away energy in the form of electron and ion waves. This is in agreement with recent numerical computations. A new definition of the sign of wave energy is given, which is valid where the old definition based on an expansion procedure breaks down. It is shown that a beam-plasma wave does not produce explosive instabilities. An eigenvalue equation describing the propagation of collisionless electrostatic drift waves in a magnetoplasma, with an arbitrary one dimensional density profile is derived. It is shown that, in general, several different waveforms exist, each with its respective dispersion relation. A numerical analysis was carried out on ion heating by a new parametric process. It was found that as the ion temperature approaches the electron temperature the heating process rapidly saturates. (auth)

5380 (COO-3070-129) NONLINEAR INTERACTION OF THREE WAVE PACKETS IN TIME AND SPACE. Bers, A.; Reiman, A. (Massachusetts Inst. of Tech., Cambridge (USA)). 1975. 5p. (CONF-750606-9). Dep. NTIS $4.50.

From 7th conference on numerical simulation of plasmas; New York, New York, USA (2 Jun 1975).

The resonant, nonlinear interaction of three coherent waves are described by the coupled nonlinear differential equations for their slowly varying amplitudes. The solutions for these equations are discussed. (MOW)

5381 (LRP-89/75) NONLINEAR MOTION OF PLASMAS IN A STRONG ELECTROMAGNETIC FIELD. Nguyen The Hung. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Sep 1975. 14p. Dep. NTIS (US Sales Only) $4.50.

A plasma subjected to a strong electromagnetic field is considered. A method is presented for obtaining the nonlinear plasma current in all orders of this field. Both electrostatic and electromagnetic perturbations are included in the calculations. The basic equations for the nonlinear plasma are described. Calculations are given of the nonlinear plasma velocity and density. (MOW)

5382 (RT/FI-(75)3) NONLINEAR DIELECTRIC PERMITTIVITY OF PLASMA WITH STRIATIONS COUPLED TO LANGMUIR'S WAVES. Cicconi, G.; Molinari, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Feb 1975. 20p. Dep. NTIS (US Sales Only) $4.50.

A generalized model, based on the theory of perturbation, suitable for explaining the propagation mechanism of moving striations in plasmas, is presented. Moment hydrodynamic equations are solved simultaneously with Poisson and Maxwell equations for longitudinal space charge waves. The equivalent nonlinear dielectric permittivity of the plasma is calculated and the dispersion equation is solved. (auth)

5383 (UCID-16776) NUMERICAL RESULTS FROM A STUDY OF LiH: THE PROPOSED STANDARD MATERIAL FOR THE HIGH PRESSURE SHOCK EXPERIMENT. Rogers, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 May 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $4.00.

It is proposed to send a high pressure shock wave through a layer of LiH and then into a sample of high Z-material, resulting in a reflected shock wave back into the LiH. If the Hugoniot and some reflected Hugoniots for LiH are known the EOS of the sample can be obtained from the "impedance matching method." The theory and its range of validity are described. (MOW)

5384 (UCRL--51946) MODE COUPLING OF ELECTRON PLASMA WAVES. Harte, J. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. Contract W-7405-Eng-48. 121p. Dep. NTIS $5.45.

Thesis.

The driven coupled mode equations are derived for a two fluid, unequal temperature (T/sub e/ much greater than T/sub i/) plasma in the one-dimensional, electrostatic model and applied to the coupling of electron plasma waves. It is assumed that the electron to ion mass ratio identical with m/sub e/M/sub i// much less than 1 and eta^2/sub ko/k lambda/sub De/ less than 1 where eta^2/sub ko/ is the pump wave's power normalized to the plasma thermal energy, k the mode wave number and lambda/sub De/ the electron Debye length. Terms up to quadratic in pump power are retained. The equations describe the linear plasma modes oscillating at the wave number k and at omega/sub ek/, the Bohn Gross frequency, and at OMEGA/sub k/, the ion acoustic frequency, subject to the damping rates nu/sub ek/ and nu/sub ik/ for electrons and ions and their interactions due to intense high frequency waves E/sub k//sup 1/. n/sub o/ is the background density, n/sub ik/ the fluctuating ion density, omega/sub pe/ the plasma frequency. (auth)

5385 DISSIPATION IN A COLLISIONLESS SHOCK WAVE. Muraoka, K. (Kyushu Univ., Fukuoka); Paul, J. W. M.; Daughney, C. C. Rep. Res. Inst. Appl. Mech. (Kyushu Univ.); 22: 135-146 (Mar 1975).

The dissipation, in a subcritical collisionless shock wave propagating perpendicular to the magnetic field, is shown to be consistent with the model of current-driven ion-wave turbulence. The observed turbulence in the shock front S(k) can be expressed by Kadomtsev's formula but reduced by a factor of $1/_{24}$. The observed effective collision frequency in the shock front nu can be expressed by Sagdeev's formula but reduced by a factor $1/_{12}$. We present a model for the stochastic heating of the electrons which explains the observed dissipation in terms of the observed turbulence. Comparison with the Kadomtsev-Sagdeev model shows that if the theoretically predicted level of turbulence is reduced by a factor $1/_{24}$ then theory and experiment are in good agreement. (auth)

5386 EXCITATION OF ION CYCLOTRON HARMONIC WAVES BY INJECTION OF A 10-keV BEAM INTO A PLASMA. Goede, A.; Massmann, P.; Hopman, H. J.; Kistemaker, J.; Brakenhoff, G. J. (EURATOM, Amsterdam). pp 633-643 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. I. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 1); CONF-741105-P1.

Measurements are presented concerning beam-plasma interactions occuring when a 1-mA, 10-keV ion beam is injected into a plasma. The relevance of these results to a tokamak neutral beam injection scheme is also discussed. The excitation of ion cyclotron harmonic waves propagating azimuthally across the applied magnetic field has been observed. The excitation is attributed to the small perpendicular velocity component of the ion beam, and is independent of the parallel velocity. Taking into account a radial variation of the beam energy, a new approach to the description of beam excitation of electrostatic instabilities in a warm plasma is outlined. (auth)

5387 EFFECT OF RANDOM DENSITY FLUCTUATIONS ON PARAMETRIC INTERACTIONS IN A PLASMA. Guzdar, P.; Kaw, P.; Satya, Y.; Sen, A.; Sundaram, A. K.; Varma, R. K. (Physical Research Lab., Ahmedabad, IN). pp 193-202 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The influence of quasi-static background random density fluctuations on three-wave parametric-coupling processes in a plasma has been investigated analytically. As an example, the case of stimulated Raman scattering is discussed in detail. After Fourier analysing the time variable and eliminating the amplitude of one of the stimulated waves, the basic equation describing the parametric process reduces to a fourth order differential equation with coefficients which are random functions of the position co-ordinate. Standard methods from the theory of wave propagation in random media can now be used. Assuming $|\epsilon(x)| = |[n(x)-n_0]/n_0| \ll 1$, analytical results correct to order $|\epsilon^2|$ are derived for the limiting cases when the correlation length of turbulence is long or short compared to the wavelength of parametrically interacting waves. It is found that in a statistically homogeneous medium, the effect of fluctuations is to en-

hance the growth length, i. e. to make the growth weaker. Next, the paper discusses convective parametric amplification in a weakly inhomogeneous medium with random density fluctuations superimposed on it. The fourth order differential equation in position space is now Fourier transformed into a second order differential equation in k-space. An expression for the convective amplification factor correct to order $|\epsilon^2|$ is obtained for the case of long-wavelength turbulence and shows that it is unaltered by the presence of background random density fluctuations. (auth)

5388 HOT-ELECTRON PRODUCTION, ANOMALOUS ABSORPTION, AND EFFECT OF INTENSE ELECTROMAGNETIC FIELDS ON INVERSE BREMSSTRAHLUNG ABSORPTION NEAR THE ELECTRON PLASMA FREQUENCY. Brownell, J. H.; Dreicer, H.; Ellis, R. F.; Ingraham, J. C. (Los Alamos Scientific Lab., NM). pp 599-608 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381 (Vol.2); CONF-741105-P2.

Measurements are presented of anomalously large microwave absorption near the electron plasma frequency omega/sub p/ by a completely ionized plasma. The threshold electric field required for the onset of anomalous absorption has been measured over a density range that is large enough to separate clearly the effects of Landau and collisional damping. Good agreement is demonstrated between these measurements and the threshold values predicted by a computer solution of the exact dispersion relation for AC parametric instabilities. Energy distribution measurements are presented for the hot, non-thermal electron tail produced by such anomalous absorption. The nature of these distributions depends strongly upon (omega/sub p//omega)^2 and microwave power. In some cases a large fraction of the anomalously absorbed power goes into less than 1 percent of the electrons and a bump develops on the hot tail. Below the threshold for anomalous absorption, the classical electron-ion collision rate, v/sub ei/, from a measurement of the inverse bremsstrahlung absorption rate has been deduced. The first experimental evidence that intense electromagnetic fields modify v/sub ei/ is reported. Observations from these experiments yield a simple empirical relation that applies for AC drift speeds as large as eE/(m omega) approximately (kT/sub e//m)/sup 1/2. Ohmic heating is minimized in these experiments by use of very short microwave pulses. (auth)

5389 COUPLED ELECTRON-PLASMA AND ION-ACOUSTIC SOLITONS EXCITED BY PARAMETRIC INSTABILITY. Ikezi, H. (Nagoya Univ., Japan); Nishikawa, K.; Hojo, H.; Mima, K. pp 609-616 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Self-modulation of the high-frequency electric field is observed when its frequency is near the electron plasma frequency. The localized field due to the self-modulation is found to make depressions in the plasma density and to be trapped in the density dip which moves with the ion-acoustic speed. The depth of the dip amounts to 20% of the unperturbed density. The maximum amplitudes of the high-frequency field and the density dip are proportional to each other. All these features are quantitatively explained by the results of the theory of coupled electron-plasma and ion-acoustic solitary waves. (auth)

5390 MEASUREMENT OF INTERACTION OF ELECTROMAGNETIC WAVES WITH NONUNIFORM PLASMA. Michaelis, M. M.; Motz, H.; Rumsby, P. T. (Oxford Univ.). pp 617-623 of Plasma Physics and Controlled Nuclear Fusion Research, 1974. Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

Results are described from two experiments set up to study the interaction between high-power electromagnetic waves and nonuniform plasmas. A pulsed CO_2 laser and a high-power magnetron are used as the radiation sources in the two experiments. In both cases, the perturbation of the plasma density profiles due to inverse bremsstrahlung absorption, followed by heating and expansion, are observed. Hollow, beam-trapping density profiles are formed. (auth)

5391 TEMPERATURE AND DENSITY PROFILES OF AN MHD SWITCH-ON SHOCK. Watson-Munro, C. N.; Bighel, L.; Collins, A. R.; Cramer, N. F.; Cross, R. C. (Univ. of Sydney). pp 673-680 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

An experimental study of the structure of MHD switch-on shock waves propagating into partially ionized hydrogen and helium plasmas is described. The variation of electron and ion temperature through the shock front was studied as a function of the level of pre-ionization. When the shock propagates into an almost fully ionized plasma, the electron temperature rises well above the ion temperature owing to resistive heating of the electrons. At low pre-ionization levels however, the ion temperature rises above the electron temperature. These results indicate that ion-neutral collisions can play a dominant role in the dissipation of energy in a shock wave. (auth)

5392 MEASUREMENT OF THE SPECTRUM OF TURBULENCE WITHIN A COLLISIONLESS SHOCK BY THE SCATTERING OF CO_2 LASER RADIATION. Perkin, R. M.; Craig, A. D.; Holmes, L. S.; Paul, J. W. M. (EURATOM-UKAEA, Abingdon, Eng.). pp 681-691 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The wave number and frequency spectra of the turbulence within a collisionless shock were measured by scattering 10.6 μm radiation from a CO_2 laser. The results extend published data from a similar shock to yield the form of the turbulent k-spectrum in the range $0.1 < k\lambda_D < 1.0$. The k-spectrum peaks around $k\lambda_D \sim 0.4$ and does not have the form predicted by weak turbulence theories. The frequency spectrum at low $k\lambda_D(\sim 0.15)$ shows the same anisotropy (turbulence directed along electron drift) as at higher $k\lambda_D(\sim 0.7)$. The peak of the frequency spectrum occurs at the expected low frequency for ion waves with $k\lambda_D = 0.15$. The broadening of the scattered radiation for both high and low $k\lambda_D$ corresponds to wave lifetimes $\tau \propto 1/\omega$. (auth)

5393 INVESTIGATION OF COLLISIONLESS SHOCK STRUCTURE IN A LONGITUDINAL MAGNETIC FIELD. El-Khalafawy, T. A.; El-Nicklawy, M. M.; Beshara, A. B.; Eteiba, M. B.; Abo-Elill, M. S.; Rudnev, N. I. (Atomic Energy Establishment, Cairo). pp 705-715 of Plasma Physics and Controlled Nuclear Fusion Research, 1974, Vol. II. Vienna; International Atomic Energy Agency (1975).

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974). See STI/PUB-381(Vol. 2); CONF-741105-P2.

The paper investigates the collisionless shock structure over a wide range of Alfvén Mach numbers ($1 < M_a < 3.5$), with M_a varying significantly along the radius. It is shown that at $M_a < 1.5$ the solitary waves propagate along the magnetic field while at $M_a > 1.5$ these waves become shock waves (in a region near the axis of the system, $r \lesssim 1$ cm). The paper also presents data which show an overturning of the front at $M_a \gtrsim M_c$ followed by plasma heating and wave destruction, i. e. damping of all field components, decreasing of M_a, widening of the front and conversion of the shock wave into plasma laminar flow. At mean Mach numbers ($M_a < 2$), a typical switch-on shock with the front separated from a piston has been registered in the region of parallel propagation. Oscillations (B_Θ, E_r, J_z) with characteristic frequencies $\omega_1 \sim (\omega_{Be}\,\omega_{Bi})^{1/2}$ and $\omega_2 \approx 2\omega_{Bi}$ have been identified ahead of the front and between the front and piston, of which those with frequency ω_1 were damped along r and z and disappeared upon the overturning of the front. (auth)

5394 WAVE CHANNELS IN AN OPAQUE PLASMA. Litvak, A. G.; Fraiman, G. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1288-1298 (Apr 1975). (In Russian)

The structure is investigated and parameters are determined for wave guide channels produced in an opaque plasma by TE and TM mode waves. Stability of plane wave guides in a medium with weak dissipation is considered. (auth)

5395 STIMULATED MANDELSTAM-BRILLOUIN SCATTERING ON PROPAGATION OF ALVEN WAVES IN A PLASMA WITH RANDOM INHOMOGENEITIES. Tamoikin, V. V.; Fainshtein, S. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 3, 948-955(Mar 1975). (In Russian)

Excitation of wave pulses on SMBS of Alfven waves in a plasma with random inhomogeneities is considered. Equations are derived for the amplitudes of interacting waves moving along a stationary magnetic field. It is shown that random inhomogeneities result in damping of the mean field and to strong phase shifts. It is found that due to the "turbulent" phase shift, resonant genera-

tion of sound harmonics should be possible. The shape of stationary nonlinear sound waves in a given field of a quasi-standing Alfven wave is determined. (auth)

5396 THREE-WAVE PROCESSES IN AN INHOMOGENEOUS PLASMA IN THE PRESENCE OF CUT-OFF POINTS. Piliya, A. D.; Fedorov, V. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 68: No. 3, 987-996(Mar 1975). (In Russian)

Three-wave processes in an inhomogeneous plasma in the presence of cut-off points are investigated. In the general case a pumping field of frequency ω_3 is related by decay interaction to three waves with frequencies ω_2 and $\omega_{1,2} = \omega_3 \pm \omega_2$. An integral transformation is proposed which reduces a set of three coupled, second order differential equations describing such interactions to a single, second order equation. The transformation is employed for solving the problem of decay of the pumping field into two waves with close frequencies. The instability in this case is absolute. Relations are derived which describe the dependence of its threshold on parameters characterizing wave dissipation and plasma inhomogeneity throughout their range of variation. Some concrete examples are considered. (auth)

5397 EXPERIMENTAL OBSERVATION OF LINEAR AND NONLINEAR ION-ACOUSTIC PHENOMENA IN A CYLINDRICAL GEOMETRY. Romesser, T. E. Iowa City, IA; Univ. of Iowa (1974). 144p. University Microfilms Order No. 75-13,814.

Thesis (Ph. D.).

Ion acoustic phenomena are studied in a cylindrical geometry for two distinct cases. A large amplitude compressive pulse is seen to evolve into solitons. The evolution of these solitons and their dependence on initial conditions show a similarity to previous work on one dimensional solitons. Dimensionless scaling arguments are used to distinguish between the two cases. In the presence of a steady state uniform cylindrical beam, approximated by a ring in V/sub r/, V/sub phi/, an ion-ion beam instability is observed. This instability exists for a limited range of beam velocities and shows a marked similarity to the strictly one dimensional ion-ion beam instability. Solution of the appropriate dispersion relation shows agreement with the observed phenomenon. (Diss. Abstr. Int., B)

5398 ANALYSIS OF WAVE-PARTICLE INTERACTIONS IN A BEAM-PLASMA SYSTEM. Winske, D. Urbana, IL; Univ. of Illinois (1974). 193p. University Microfilms Order No. 75-11,803.

Thesis (Ph. D.).

Several mechanisms to explain the saturation of the beam plasma instability and the simultaneous broadening of the beam energy distribution function for the case where the beam is cold and weak and the plasma is cold and collision dominated are explored. One mechanism involves the trapping of the beam in a single spatially growing wave. A set of dynamic equations, similar in some respects to those of O'Neil et al., are integrated numerically. The inclusion of collisions produces several new features: the wave slows down in the saturation region and part of the beam (20-40 percent) remains untrapped. Agreement of the calculated beam distribution function and the electric field at saturation with the experimental results of Bohmer, Chang, and Raether is not too good. An estimate of the importance of collisions between trapped particles using a moment approach shows that the effect of such collisions is negligible. A second mechanism considers the thermalization of the beam by its interaction with random, spatially growing waves. Saturation is achieved when the beam is heated sufficiently, through a process called collisional quenching. A calculation using a simple form for the wave spectrum indicates that the correlation time is too long for true randomization of the beam, although the saturation field is of the correct size. An exact expression for the electric field derived by Evans is analyzed and then used to improve the calculation of the correlation time. A third mechanism, nonlinear orbit modification, is briefly considered. (Diss. Abstr. Int., B)

5399 FREQUENCY MIXING OF ELECTROMAGNETIC WAVES IN PLASMAS BY COLLISIONAL PROCESSES. Clynch, J. R. Providence; Brown Univ. (1974). 145p. University Microfilms Order No. 75-9137.

Thesis (Ph. D.).

The problem of calculating the scattered electromagnetic radiation at mixed frequencies when two or more electromagnetic waves pass through a plasma is considered. The Boltzmann equation for the spherical moments of the electron distribution function is obtained and solved in the perturbative limit. A system of diagrams is developed to enable easy identification and calculation of all terms of a given order. The nonlinear currents at the frequency $\text{omega}_1 - 2\ \text{omega}_2$ induced by parallel pencil beams of linearly and circularly polarized waves are calculated. The current at the frequency $\text{omega}_1 + \text{omega}_2$ is calculated for the case of perpendicular propagation of the initial waves. The energy re-radiated from these currents in these cases is calculated. The re-radiation from the currents throughout the volume where the two waves are present can be made to add coherently under certain conditions forming a narrow beam. An estimate of the energy flux at $\text{omega}_1 - 2\ \text{omega}_2$ generated by megawatt level radio waves passing through the ionosphere is made. It is suggested that with proper choice of frequencies (omega_1 and omega_2 in the 5 to 10 MHz region) this radiation should be detectable with currently available radio antenna and will provide a direct measure of the effective electron collision frequency. An estimate of the radiation at $\text{omega}_1 + \text{omega}_2$ from lightly doped semiconductors when two laser pulses intersect at right angles is made. (Diss. Abstr. Int., B)

ENGINEERING

Refer also to abstract 6512.

Energy Conversion

Refer also to abstracts 5664–5667, 5670, 5672, and 5895.

5400 DESIGN OF A THERMOELECTRIC CONVERTER USING 3M HIGH PERFORMANCE THERMOELECTRIC MATERIAL. Hampl, E. F. Jr.; Hinderman, J. D.; Mitchell, W. C.; Reylek, R. S.; Wald, D. A. (3M Co., St. Paul). pp 714-722 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812–.

Facilities and Equipment

Refer also to abstracts 6767 and 6867.

5401 (UCRL-76125) SOME ASPECTS OF MICRO-DRILL TECHNOLOGY. Ellers, R. C.; Spies, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1974. 4p. (CONF-741108-6). Dep. NTIS $4.00.

From society of manufacturing engineers conference; San Francisco, California, USA (19 Nov 1974).

Providing research equipment for the many and varied projects at Lawrence Livermore Laboratory leads to interesting machining requirements. One of these is the need to drill very small holes, and in a variety of materials. Holes down to 0.001 in. in dia, approximately 12 dia deep, in brass, steel, stainless steel, copper, gold, plastics, uranium, etc., are not uncommon. This paper discusses methods of sharpening microdrills down to .001 in. in dia and some results obtained with their use. (TFD)

5402 (UCRL-77350) 19 mm BALLISTIC RANGE: A POT-POURRI OF TECHNIQUES AND RECIPES. Carpluk, G. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Sep 1975. 18p. (CONF-750981-2). Dep. NTIS $4.00.

From 26th meeting of the aeroballistic range association; San Leandro, California, USA (30 Sep 1975).

The expansion of ballistic gun range facilities at LLL has introduced state-of-the-art diagnostic techniques to glovebox-enclosed ballistic guns systems. These enclosed ballistic ranges are designed for the study of one-dimensional shock phenomena in extremely toxic materials such as plutonium. The extension of state-of-the-art phtographic and interferometric diagnostic systems to glovebox-enclosed gun systems introduces new design boundaries and performance criteria on optical and mechanical components. A technique for experimentally evaluating design proposals is illustrated, and several specific examples (such as, target alignment, collateral shrapnel damage, and soft recovery) are discussed. (auth)

5403 (UCRL-77352) GLOVEBOX-CONTAINED FORTY-MILLIMETER GUN SYSTEM FOR THE STUDY OF ONE-DIMENSIONAL SHOCK WAVES IN TOXIC MATERIALS. Honodel, C. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Sep 1975. 10p. (CONF-750981-1). Dep. NTIS $4.00.

From 26th meeting of the aerocallistic range association; San Leandro, California, USA (30 Sep 1975).

A new gun system is being constructed at the Lawrence Livermore Laboratory for studies of the behavior of toxic materials under shock-loaded conditions. Due to the extreme toxicity of some materials, such as plutonium, the entire gun system must be enclosed in gloveboxes. Some of the experimental requirements that affected the design of the system, various diagnostic techniques that will be employed with the system, and some details of the final design that is presently under assembly are presented. (auth)

5404 (Y-DA-6375) HIGH TEMPERATURE ELECTRICAL CONDUCTIVITY APPARATUS. Lore, J. D.; Ward, M. E.; Richards, H. L.; Stewart, J. H. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1975. Contract W-7405-eng-26. 15p. (CONF-751056-1). Dep. NTIS $4.50.

From American Chemical Society southeastern-southwestern regional meeting; Memphis, Tennessee, USA (29 Oct 1975).

The design and application of a high temperature test facility comprising a furnace built in the form of a box wherein one or more walls are removable to facilitate access to interior components comprising the conductance cell are described. The system has been used for measuring the electrical conductivity of slags and molten salts. The bridge circuit for conductance measurements is described. (WHK)

Lasers

Refer also to abstracts 6296 and 6655.

5405 (LA-UR-75-2155) COLD CATHODE ELECTRON GUNS IN THE LASL HIGH POWER SHORT-PULSE CO_2 LASER PROGRAM. Singer, S.; Ladish, J. S.; Nutter, M. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 24p. (CONF-751108-14). Dep. NTIS $4.50.

From 1st international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

The design, operation, and performance of the 200 x 35 cm^2 two-sided cold cathode electron gun used in the 2.5 kJ laser system and to be used in the 10 kJ laser are described. (MOW)

5406 (LBL-3916) FEASIBILITY AND ADVANTAGES OF OFF-RESONANCE LASERS IN CHEMICALLY REACTING SYSTEMS. Harris, C. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 15p. (CONF-750683-1). Dep. NTIS $4.00.

From 27th international meeting of the Societe de Chimie Physique; Paris, France (17 Jun 1975).

The problem of understanding the semiclassical description of the time evolution of an ensemble of two state systems under the influence of a coherent radiation field is of considerable importance. Previous attempts to deal with these problems have dealt with either broad pulses or ultrashort pulses which allow the use of the rate equations or finite phase memory to be incorporated into the description. In neither case, however, has the effect of incoherent feeding and off-resonance effects in a coherently driven two-level system been analyzed. A closed form solution that includes the effects of relaxation and spontaneous emission between the two levels has been obtained for the general case when the ensemble is being incoherently fed from a population reservoir, as would be the case, for example, in a chemical laser. In addition to providing a basis for understanding the modifications which occur for such a system, the mathematical formulation predicts that an important effect may be observed. This effect, which is termed "kinetic coherence," is the production of a long-term coherent component that results directly from the kinetic feeding. The magnitude of the component is related to the rate of creating excited states, relaxation pathways and the off-resonance frequency. It is shown how, in principle, it is possible to utilize these off-resonance effects in any inhomogeneously broadened system to significantly overcome the losses from T_2 relaxation processes and to provide an experimental system capable of controlling the relative ratio of spontaneous and stimulated emission. Finally, the relationships between chemical kinetics, the off-resonance feature and sustained self-regulation in a system exhibiting gain are discussed. (auth)

5407 (SAND-75-0287) TECHNIQUE FOR PRECISE ALIGNMENT OF SMALL DIAMETER LASERS. McCarthy, A. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1975. Contract AT(29-1)-789. 8p. Dep. NTIS $4.00.

The technique is applicable in the alignment of any laser, but is especially valuable if the dia of the lasing medium is small, and/or one of the mirrors in the laser cavity is curved. (auth)

5408 (UCID-16931) PIEZO-ELECTRIC FLUID DYE CELL PUMP. McWilliams, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Aug 1972. Contract W-7405-Eng-48. 14p. Dep. NTIS $4.50.

A reliable and compatible pump for a mode-locked oscillator flowing dye cell or other applications utilizing a piezo-electric crystal is described. (auth)

5409 (UCRL-77203) PHYSICS OF RELATIVISTIC ELECTRON BEAMS IN RECTANGULAR AND CYLINDRICAL GEOMETRIES. Schlitt, L. G.; Bradley, L. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. 22p. (CONF-751108-10). Dep. NTIS $4.50.

From 1st international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

The use of electron beams for the direct pumping of lasers for fusion applications requires the generation of large area beams in appropriate geometries. Two geometries which are of particular interest are rectangular electron beams with planar anodes and radially converging beams with cylindrical anodes. The generation of such beams requires the management of electron trajectories in a complex combination of applied and self-generated electric and magnetic fields. The beam's self-electric field limits the emitted current and the deflection of the electron in the self-

magnetic field (beam pinch) limits the beam area that can be generated from a single cathode. A simple analytic model is used to derive a scaling relationship for beam pinch in both geometries of the form V/sup 1/2/ w/d equals alpha where V is the diode voltage, w the beam width, d the anode-cathode spacing, and alpha is a weak function of the geometry. Numerical calculations are presented to show the effects of nonuniform electric fields encountered in typical geometries together with supporting experimental measurements. (auth)

5410 (UCRL-77213) ELECTRON-BEAM PUMPING OF VISIBLE AND ULTRAVIOLET GAS LASERS. Bradley, L. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Sep 1975. 100p. (CONF-750970-1). Dep. NTIS $8.00.

From proceedings on the physics and technology of high power gas lasers; Capri, Italy (22 Sep 1975).

Several techniques for using direct electron-pumping of gas lasers are reviewed. The primary objective is to categorize pump geometries and to give guidelines for gun selection and pulser design. Examples and application of pump technology are given. (auth)

5411 RECENT DEVELOPMENTS IN HIGH POWER GAS LASERS. Finkleman, D.; Greenberg, R. A. Paper 75-297. New York; American Institute of Aeronautics and Astronautics (24 Feb 1975). 16p.

From 11th annual meeting and technical display; Washington, DC (24 Feb 1975).

A unified discussion of the frequently conflicting requirements of efficient mass flow utilization, good beam quality, and capability to exhaust the waste gas from the laser cavity is presented for gasdynamic, chemical, and electrical laser systems. It is shown that specific powers of hundreds of KJ/lbm are theoretically possible in flowing gas lasers. A simple analysis which illustrates the importance of that and several other parameters is given, and the principle of operation of representative high-power lasers is reviewed. The importance of volumetric excitation, power extraction, and waste energy removal is discussed. Finally, a recent major development in each area of gasdynamic, electrical, and chemical lasers is illustrated. (IAA)

5412 AMPLIFICATION IN A γ LASER ON OBEYANCE OF THE BRAGG CONDITION. Andreev, A. V.; Il'inskii, Yu. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 3, 811-816(Mar 1975). (In Russian).

Amplification in a γ laser under Bragg diffraction conditions is considered. It is shown that the highest amplification can be attained in crystals consisting of excited isotopes with a maximal multiplicity and minimal nuclear transition energy. (auth)

5413 PLASMA PARAMETERS IN THE POSITIVE COLUMN He–Cd^+ LASERS. Mizeraczyk, J. K. (Inst. of Quantum Electronics, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 23: No. 5, 43-48(1975).

Electric field, electron temperature and density have been measured over the whole range of the typical He–Cd^+ laser discharge conditions with the modified double-probe method. The results can be used for explanation of the saturation effects in He–Cd^+ lasers. (auth)

5414 MODULATION OF He–Ne LASER RADIATION BY STRIATIONS. Zakharenko, Yu. G. Opt. Spektrosk.; 37: 990-991(Nov 1974). (In Russian)

The effect of interacting striations in a two-anode discharge tube on the modulation of laser radiation was studied. The lowest modulation of He-Ne laser radiation is caused by synchronized striations with a phase shift of 180 degrees. Modulation up to 5 to 10% is found outside the synchronization band. Greater modulation (up to 15%) is caused by the appearance of striations in the cathode branch. (IAA)

5415 USE OF ORGANIC DYE SOLUTIONS FOR SUMMATION OF THE RADIATION OF SEVERAL LASERS. Anufryk, S. S. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 119-122(1975). (In Belorussian)

It is shown that the appearance of thermo-optical inhomogeneities in the active medium of the summator is the most significant obstacle to the use of organic dyes as an effective summator of the radiation of lasers with pulse duration of $\sim 10^{-8}$ s. This is caused by the low efficiency of transformation (<10%) and the large divergence of the radiation. (tr-auth)

5416 DISTRIBUTION OF ABSORBED PUMP POWER IN FLASHLAMP-PUMPED DYE LASERS. Blit, S.; Ganiel, U. (Weizmann Inst. of Science, Rehovoth, Israel). Opt. Quant. Electron.; 7: 87-93(Mar 1975).

A method is described for calculating the radial distribution of the absorbed power density inside the dye solution of a flashlamp-pumped dye laser. The calculation takes into account both the geometrical parameters (dia of the dye tube, wall thickness) and the relevant physical parameters, such as the indices of refraction of the tube material and the dye solution, dye concentration, absorption spectrum of the dye, and emission spectrum of the flash. The calculation is based on the Monte Carlo method and is particularly suitable for machine computations. After a detailed description of the method of calculation, it is demonstrated for the practical case of the dye Rhodamine 6G dissolved in ethanol. Some of the absorption profiles thus obtained are compared with fluorescence profiles measured by Gassman and Weber (1971). (auth)

5417 TUNABLE LASERS. Colles, M. J.; Pidgeon, C. R. (Heriot-Watt Univ., Edinburgh). Rep. Prog. Phys.; 38: 329-460(1975).

The principal techniques for obtaining tunable laser radiation from the near-ultraviolet to the infrared region of the spectrum are reviewed both from the point of view of their state-of-the-art device operation and technology. An attempt has been made to give a comprehensive account of the most recent applications of these techniques. The term tunable lasers is arbitrarily defined to mean lasers which are broadly tunable over 100 cm^{-1} or more, and includes dye lasers, optical parametric oscillators, spin-flip Raman lasers and semiconductor diode lasers. The tunable lasers are compared and contrasted in terms of tuning ranges, powers, linewidths, and stability; it is concluded that where the systems overlap they are complementary, with no one system being better in every respect for all applications. (auth)

5418 SIMPLE BEAM EXPANDER FOR FREQUENCY NARROWING OF DYE LASERS. Hanna, D. C.; Karkkainen, P. A.; Wyatt, R. (Southhampton Univ., Eng.). Opt. Quant. Electron.; 7: 115-119(Mar 1975).

Design considerations and performance of a prism beam expander are presented. Using a prism beam expander and holographic grating, a dye laser pumped by a nitrogen laser has given 15 kW of diffraction-limited power in a linewidth of 0.1 to 0.2 per cm. Addition of a single etalon gave a single frequency output of 10 kW in a linewidth of less than 0.01 per cm. (auth)

5419 DYNAMICS OF THE DICKE LASER MODEL IN THE CLASSICAL REGION. I. Scharf, G. (Univ., Zurich). Helv. Phys. Acta; 48: No. 3, vp(1975).

The dynamics of the Dicke model describing N spins ($s = \frac{1}{2}$) interacting with a single mode of the radiation field is investigated in the limit $N \to \infty$. It is shown that this limit corresponds to the classical limit $H \to 0$ of quantum mechanics. The time evolution of the initial state with all N spins in the upper level is then studied, using the semi-classical asymptote of quantum mechanics. The result is applied to calculate the second-order normal ordered photon correlation function, which is of particular interest because it shows a slow decay of coherence for large times. (auth)

5420 PREPULSE EXTINCTION-RATIO MEASUREMENTS ON A CO_2-LASER SYSTEM. Manes, K. R.; Smith, D. L.; Haas, R. A.; Glaros, S. S. (Univ. of California, Livermore). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 635-636(Aug 1975).

Prepulse extinction-ratio measurements performed on two pulse-selection systems at the input and the output of a CO_2-amplifier chain are described. (auth)

5421 NEW CO_2 PUMPED CW FAR-INFRARED LASER LINES. Jennings, D. A. (National Bureau of Standards, Boulder, CO); Evenson, K. M.; Jimenez, J. J. IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 637(Aug 1975).

A single-frequency cw CO_2 laser has been used to pump ethyl alcohol, methyl chloride, ethyl chloride, and methylene chloride, generating 8 new cw far-infrared (FIR) laser lines from 254 to 1700 mum. (auth)

5422 LASER APPLICATION OF HEAT PIPE TECHNOLOGY IN ENERGY RELATED PROGRAMS. Carbone, R. J. (Los Alamos Scientific Lab., NM). pp 1528-1532 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The design of a heat pipe laser is proposed and its application to isotope separation and fusion is discussed. (TFD)

5423 THERMOOPTICAL EFFECTS OF INTRACAVITY $Ba_2Na(NbO_3)_5$ ON A FREQUENCY-DOUBLED Nd:YAG LASER. Barry, J. D.; Kennedy, C. J. (Air Force Avionics Lab., Wright-Patterson AFB, OH). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 575-579(Aug 1975).

The two major thermooptical influences on a frequency-doubled Nd:YAG laser by an intracavity $Ba_2Na(NbO_3)_5$ crystal are discussed and theoretically examined. The absorption of lambda 106- and lambda 0.53-mu m power by the crystal is shown to lead to the formulation of a thermally induced lens and diffraction loss due to the aspherical distortion. Equations for each are formulated. The effects of the lens and diffraction loss to the performance of the laser are illustrated. The modification to the laser resonator due to the inclusion of these effects is discussed. (auth)

5424 THEORY OF POROUS WALL CAPILLARY TUBES FOR FLOWING GAS LASERS. Papoyoanou, A. (Army Electronics Command Lab., Fort Monmouth, NJ); Fujisawa, A. IEEE (Inst. Electr. Electron. Eng) J. Quant. Electron.; QE-11: No. 8, 579-583(Aug 1975).

Flowing gas capillary lasers exhibit high optical gains. However, as a result of the linear axial pressure variation in the tube bore, gain and saturation intensities are not axially uniform. This pressure variation can be reduced by introducing the gas into the tube bore through the walls of a porous capillary tube. Analysis of the gas flow shows that the axial pressure variation in the porous wall tubes is more gradual than for dense wall tubes leading to more uniform gain conditions. The saturation intensity is more uniform not only due to the reduced pressure anisotropy but also, at higher flow rates, because of axially varying particle dwell times in the discharge region. (auth)

5425 TE CO_2 LASER PULSE DECAY AND MOLECULAR RELAXATION RATES. Garside, B. K.; Reid, J.; Ballik, E. A. (McMaster Univ., Hamilton, Ont.). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 583-589(Aug 1975).

A theoretical model for TE CO_2 laser dynamics is presented, incorporating the effects of coupling between the rotational sublevels of the laser vibrational states associated with the 10.4-mu m transition. It is shown that proper incorporation of this coupling is extremely important for modeling both the initial gain-switched output peak and the subsequent rate at which the radiation energy decays away. In particular, it is demonstrated that the latter rate is a measure of the rate at which energy is removed from the lower laser level. The lower laser level is coupled to the bending mode by several relatively rapid vibrational energy exchange processes. The coupled bending and asymmetric stretching modes then lose energy at a much slower rate, controlled by the conversion of vibrational energy to translational energy. A proper choice of initial laser level populations allows the decay rate of the pulse tail to be controlled by either one of these. A novel experimental technique is described which allows the two ranges of operation to be explored. A comparison between theory and experiment produces excellent agreement, and the results are employed to determine values for the relevant rates. (auth)

5426 INFLUENCE OF OXYGEN ON CO-LASER PERFORMANCE. Keren, H.; Avivi, P.; Dothan, F. (Hebrew Univ. of Jerusalem). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 590-594(Aug 1975).

Additions of a few parts per thousand of oxygen to a CO-He mixture change drastically the laser output power, the axial field in the positive column, and the slope of the E-I curve of the discharge. The intensity of the spectrum of vibrational transitions of the CO molecule increases when oxygen is added; the increase is especially pronounced for transitions from higher (u greater than 7) levels. The most prominent feature in the visible spectrum is the disappearance of the C_3-Swan bands with the addition of oxygen. The populations of CO vibrational levels were derived from the IR spectra; they increase by more than an order of magnitude for u greater than 7. The electron energy distribution was derived from measured E/N and the Boltzmann equation. Oxygen affects the Boltzmann equation (and thus the electron energy-distribution function) through the change in E/N, which is in turn determined by ionization and deionization processes. The fractional power transfer from electrons increases to vibrational levels and decreases to electronic levels. (auth)

5427 STUDIES OF RELAXATION OSCILLATIONS IN ORGANIC DYE LASERS. Lin, C. (Bell Laboratories, Holmdel, NJ). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 602-609(Aug 1975).

The transient phenomena of relaxation oscillations and "initial spikes" in organic dye lasers are studied experimentally and theoretically. Both damped relaxation oscillations and initial spikes are clearly observed in N_2 laser-pumped dye lasers under appropriate conditions which are furthermore shown to agree with theoretical considerations. Linearized rate equations obtained with small-signal approximation are used to describe the initial-spiking phenomenon; for the more general phenomenon of relaxation oscillations computer solutions of the coupled rate equations are obtained. Comparisons with experimental observations show excellent qualitative agreement. Based on the results of these studies, a general technique using the idea of controlled resonator transients is described for tunable subnanosecond pulse generation from laser-pumped dye lasers in the near UV and the visible region of the spectrum. (auth)

5428 10.6-mu m WAVEGUIDE LASER POWER AMPLIFIER. Klein, M. B.; Abrams, R. L. (Hughes Research Labs., Malibu, CA). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 609-615(Aug 1975).

The results of a study intended to characterize the properties of cw 10.6-mu m waveguide power amplifiers are reported. The analysis considers both single- and double-pass devices, and includes the effects of gain narrowing and power broadening. Experiments on a 1.65-mm-bore device with an active length of 77 cm have been performed. Gains as high as 17 dB/m have been measured at room temperature. (auth)

5429 CHIRP MODULATED CO_2 WAVEGUIDE LASER. Stein, A. (United Aircraft Research Labs., East Hartford). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 630-631(Aug 1975).

Repetitive chirp modulation of a stable CO_2 waveguide laser yielded chirps of 75-MHz width and 2-mus duration. A demodulation technique is demonstrated which permits coherent detection of such a signal for periods extending over many chirps. (auth)

5430 RECIRCULATING, SELF-CONTAINED DF/HF PULSED LASER. Fradin, W.; Chenausky, P. P.; Freiberg, R. J. (United Technologies Research Center, East Hartford). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 631-633(Aug 1975).

The operation of the first self-contained, recirculating, electrically initiated, pulsed chemical laser is reported. A unique combination of scrubber beds selectively removes ground-state DF(HF) and other deleterious gases from the recirculating gas flow. By providing a small gas replenishment, it is possible to operate the laser for extended periods of time with little loss in power. The processes that degrade the power output in the absence of chemical scrubbing are discussed. (auth)

5431 GUIDE TO MODE LOCKING. Cunningham, R. C. Electro-Opt. Syst. Des.; 7: 4A-6A; 8A-11A(Apr 1975).

A conceptual, nonmathematical explanation of the phenomenon of mode locking is presented. History, loss modulation, phase modulation, saturable absorbers, other mode locking methods, frequency shifting and pulse compression, pulse selection, direct measurements, and indirect measurement are discussed. (IAA)

5432 INDEPENDENT POWER-SUPPLY CIRCUIT FOR A PULSED SOLID-STATE LASER. Dubinker, A. S.; Nilov, E. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 529-530 (1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 164-165(1975).

A power supply for a pulsed solid-state laser using a low-voltage primary source (a storage battery) is described. The circuit uses the principle of time compression of current pulses while simultaneously increasing the voltage by means of nonlinear magnetic sections. The efficiency of the circuit may be made to exceed 0.5. (auth)

5433 USE OF THE MOLECULES CD_3I, CH_3I, AND CD_3Cl AS ACTIVE MATERIAL OF SUBMILLIMETER LASERS WITH OPTICAL PUMPING. Dyubko, S. F.; Fesenko, L. D.; Baskakov, O. I.; Svich, V. A. Zh. Prikl. Spektrosk.; 23: No. 2, 317-320 (Aug 1975). (In Russian).

Submillimeter generation in the 0.2 to 2 mm range was obtained for the molecules CD_3I, CH_3I, and CD_3Cl by the direct pumped radiation of CO_2 lasers. The frequency of the majority of the radiation lines were measured with an accuracy of 2×10^{-6}. The intensity and polarization with respect to the polarization of the pumping radiation were also measured. Some radiation lines of CD_3I were also measured. Some radiation lines of CD_3I were identified. The values of the constants B (6053.29 MHz), D_J (3.75 kHz), D_{JK} (4.68 kHz), and (-1.068 MHz) were calculated in the oscillation state ν_3 and D_J in the states ν_2 and $2\nu_3$ (3.22 and 3.77 kHz, respectively). (tr-auth)

5434 INVESTIGATION OF A PULSED CO_2 LASER WHEN THE ACTIVE MEDIUM IS STIMULATED BY MICROSECOND CURRENT PULSES. Baloshin, Yu. A.; Aver'yanov, N. E. Tr., Leningr. Inst. Tochn. Mekh. Opt.; No. 79, 25-33(1975). (In Russian).

A study was made of a pulsed CO_2 laser when the active mixture was stimulated by microsecond pulses. Based on analysis of experimental curves for the peak emission power of a CO_2 laser for different mixtures as a function of the discharge current amplitude, it is noted that with increasing concentration of N_2 in the mixture, the optimum current for peak power decreases, while

on the contrary, the addition of He raises the optimum current. In investigating the dependence of maximum peak power on additives of nitrogen and helium it is established that even when the partial pressure of nitrogen is greater than the helium pressure, the emission power in a pulse continues to rise. An analysis of the time development of the emission pulse showed that under given conditions of stimulation of emission a slight shift, $\Delta\tau$, arises which is approximately equal to the duration of the stimulating current pulse. An investigation is made of the influence of nitrogen on τ_{em} (duration of emission pulse), τ_i (duration of a current pulse) and $\Delta\tau$ (shift of the emission pulse relative to the current pulse). First of all it is noted that there is an increase in τ_{em} and broadening of the current pulse (by a factor of about 2) with an increase in molecular nitrogen pressure. The shift $\Delta\tau$ has a maximum. In addition, a check on the time development of emission revealed yet another interesting circumstance: in a time of the order of hundreds of μs after the first emission pulse which arises with a short delay relative to the current pulse, a second pulse of lower amplitude arises with a duration of the order of a few tenths of a μs, which disappears at high currents. An estimate is made of the influence of the partial pressure of helium on development of the second pulse, and the results are discussed. (Ref. Zh.)

5435 EFFECT OF CERIUM AND IRON ON THE GAMMA STABILITY OF NEODYMIUM-ACTIVATED GLASS. Buzhinskii, I. M.; Avakyants, L. I.; Surkova, V. F. Zh. Prikl. Spektrosk.; 23: No. 2, 238-242(Aug 1975). (In Russian).

The effect of additions of Ce and Fe on the γ stability of PGLS-1 and PGLS-4 silicate laser glass was examined. The formation of color centers in the uv, visible, and ir spectral regions was observed. The increase of the absorption in the uv and visible regions was analogous to that described in the literature for silicate glass. The induced absorption in the ir is connected primarily with the transition of Fe from the ferric oxide form to the ferrous. It seems to be a basic factor deteriorating the generation parameters of laser glass. Between the generation efficiency and the induced absorption there is an exponential dependence on the generation wave length. Additions of Ce sharply improve the γ stability of the glass. (tr-auth)

5436 ATMOSPHERIC-PRESSURE PULSED CO_2 LASER. Aver'yanov, N. E. Tr., Leningr. Inst. Tochn. Mekh. Opt.; No. 79, 33-40(1975). (In Russian).

A pulsed TEA CO_2 laser with double discharge which is described operates in the isolated-pulse mode with gentle pumping of the working mixture is described. Under total pressure equal to atmospheric pressure and a mixture composition of $CO_2:N_2:He$ = 1:1:15 the energy of emission in a pulse was 1.2 J. An attempt is made to use a sliding discharge as a source of ultraviolet radiation to preionize the main discharge in a pulse TEA CO_2 laser. With the described cavity at a voltage of 60 kV across the main discharge gap in a mixture of $CO_2:N_2:He$ = 1:1:3 and atmospheric pressure, the emission energy in a pulse was 5 J. The energy contributed to the discharge is limited by the electric power supply circuit, and not by the disruption of its nonuniformity. An increase of emission energy involves the necessity of selecting a cavity with optimum parameters. At present detailed studies are being done on the developed laser, and its structural and electrical parameters are being optimized. (Ref. Zh.)

5437 EFFECT OF THE STRUCTURAL DIFFERENCES OF FLASH TUBES ON THE EFFICIENCY OF SOLID-STATE LASERS. Basov, Yu. G.; Makarov, V. N.; Narkhova, G. I.; Tokareva, A. N.; Usova, V. M. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 8, 83-88(Aug 1974).

Translated from Radiolekh. Elektron.; 19: No. 8, 1702-1707 (Aug 1974).

The effect of structural differences of xenon flash tubes with discharge gap dimensions of 6 mm diameter and 80 mm length and different ballast volumes beyond the electrodes on the efficiency on neodymium glass, ruby and YAG:Nd^{3+} lasers has been investigated. For all three active media the pumping efficiency using tubes with small ballast volumes is 20-30% higher than that with light sources having enlarged ballast volumes although the electrical, spectral and light characteristics of these lamps are little different. The fall-off in efficiency is due to the drift of the radiating volume of gas into the ballast volumes during the flash. This is equivalent to an increase in the length of the light-emitting portion of the lamp compared with the length of the active element of the laser when the specific power of the discharge is reduced. (auth)

5438 MEASUREMENT OF FLUCTUATIONS IN A TRAVELING-WAVE LASER. Mazan'ko, I. P.; Molchanov, M. I.; Yaroshenko, N. G. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 8, 80-83(Aug 1974).

Translated from Radiolekh. Elektron.; 19: No. 8, 1698-1701 (Aug 1974).

The amplitude and frequency fluctuation spectra of a travelling wave laser are investigated for different lasing powers. The technical and the natural line width of the laser radiation are estimated. (auth)

5439 SELECTION OF THE OPERATING TEMPERATURE OF NEODYMIUM GLASS LASERS. Mit'kin, V. M.; Schchavelev, O. S.; Bunkina, N. N. Zh. Prikl. Spektrosk.; 23: No. 2, 218-223(Aug 1975). (In Russian).

The change in sign induced in the active element of thermal lenses during deviation of the laser operating temperature from the optimum was shown experimentally. It was also shown that during operation close to the optimum temperature the change in the glass parameters across the active element, caused by the inhomogeneous temperature field, significantly affects the spatial and energetic characteristics of the laser radiation. (tr-auth)

5440 CONSTRUCTION OF CO_2-N_2 LASER. Sinha, R. S.; Swarup, P. (Solid State Physics Lab., Delhi). Indian J. Pure Appl. Phys.; 13: No. 6, 377-380(Jun 1975).

Design considerations and fabrication of a CO_2 laser capable of yielding 3 W output power at the fundamental axial modes are discussed. The laser is simple in construction and its plasma mixture comprises CO_2 and air only. A sensitive photon-drag detector has been employed for the detection and estimation of the laser power. (auth)

5441 RATE EQUATIONS FOR A THREE-LEVEL SYSTEM INTERACTING WITH RADIATION. Venkatesh, H. G.; Guha, S. N.; Prasad, S. (Birla Inst. of Technology, Mesra, India). Indian J. Phys.; 49: No. 2, 138-142(Feb 1975).

It is shown that for short intervals the instantaneous population difference (Δn) varies linearly with time. The general solution of the rate equations is also obtained by taking constant induced transition probability between the lasing levels. The power emitted is found to vary exponentially with time which reaches a maximum value at a time (t_m) determined by relaxation times, induced transition probabilities and the spectral scheme. (auth)

5442 LASERS AND SOLID-STATE APPLICATIONS IN NUCLEAR ENGINEERING. Kikuchi, C.; Duderstadt, J. J. (Univ. of Michigan, Ann Arbor). Nucl. Technol.; 27: No. 1, 57-59(Sep 1975).

Both solid-state physics and laser applications have played important roles in the research and educational activities of many nuclear engineering programs. There are a number of ways in which nuclear engineering programs have contributed to these fields over the past two decades. The field of applied physics has evolved within the nuclear engineering discipline, and it might be expected to have an input on nuclear engineering in the future. (auth)

5443 GASEOUS AND QUANTUM ELECTRONICS IN NUCLEAR ENGINEERING EDUCATION. Wells, W. E. (Univ. of Illinois, Urbana). Nucl. Technol.; 27: No. 1, 51-56(Sep 1975).

The roles of gaseous and quantum electronics in nuclear engineering, and consequently in nuclear engineering education, are growing at a significant rate. The nuclear engineering program of the University of Illinois currently has 10 students, out of a total graduate student enrollment of 90, specializing in these areas. Course work follows an interdisciplinary approach to supplement the basic nuclear engineering core of courses. Research is primarily focused on radiation-induced plasmas. Both theoretical and experimental aspects are investigated; however, the major effort is devoted to the study of radiation coupling to laser plasmas. This coupling has been shown by the enhancement of electrical lasers and by the direct nuclear pumping of laser plasmas. A typical example of this research is a study of a gas mixture of He-Ne-O_2 irradiated by neutrons from the University of Illinois TRIGA reactor. Although conclusive proof of lasing has not been demonstrated, indications of gain and a population inversion have been achieved. (auth)

5444 DISTRIBUTED-FEEDBACK DOUBLE-HETEROSTRUCTURE GaAs INJECTION LASER WITH FUNDAMENTAL GRATING. Anderson, D. B.; August, R. R.; Coker, J. E. (Rockwell International Corp., Anaheim, CA). Appl. Opt.; 13: No. 12, 2742-2744 (Dec 1974).

The pulse operation of two DFB GaAs junction lasers employing the fundamental grating order at 77°K for double-heterostructures formed by both liquid and vapor phase epitaxy is described. (TFD)

5445 LIGHT INTENSITY OF THE FUNDAMENTAL TEM_{00} MODE OF A He-Ne GAS LASER WITHOUT BREWSTER WINDOWS: ACHIEVEMENT OF A POLARIZED RECTILINEAR LASER BEAM OF STABLE INTENSITY. Mas, G.; Blancher, H.; Roig, J. (Univ. of Sciences and Techniques, Montpellier, France). Appl. Opt.; 13: No. 12, 2771-2773(Dec 1974).

A laser is described that gives successive longitudinal modes that are polarized in a rectilinear manner alternately, following two perpendicular directions pi and sigma. If a fixed polarizer is placed on the outcoming beam, the passage of the modes within the Doppler line causes important fluctuations with time reaching 30 to 40 percent of the mean intensity. Rotation of the polarizer causes a modulation of the beam; the light intensity remains approximately stable within about 1 percent if the polarizer is placed at 45^0 to the pi and sigma vibrations. A better stabilization of intensity and a well-defined rectilinear polarized beam are obtained by eliminating the polarizer and applying a magnetic field H of about 100 G perpendicular to the axis of the laser cavity, along 6 cm of the capillary tube of the laser. The beam becomes 99 percent polarized, and all the energy is emitted in the modes pi parallel to the magnetic field H. (TFD)

5446 MODE CALCULATIONS IN UNSTABLE RESONATORS WITH FLOWING SATURABLE GAIN. I. Hermite–Gaussian Expansion. Siegman, A. E. (Stanford Univ., CA); Sziklas, E. A. (Stanford Univ., CA). Appl. Opt.; 13: No. 12, 2775-2792 (Dec 1974).

A procedure is presented for calculating the three-dimensional mode pattern, the output beam characteristics, and the power output of an oscillating high-power laser taking into account a nonuniform, transversely flowing, saturable gain medium; index inhomogeneities inside the laser resonator; and arbitrary mirror distortion and misalignment. The laser is divided into a number of axial segments. The saturated gain-and-index variation across each short segment is lumped into a complex gain profile across the midplane of that segment. The circulating optical wave within the resonator is propagated from midplane to midplane in free-space fashion and is multiplied by the lumped complex gain profile upon passing through each midplane. After each complete round trip of the optical wave inside the resonator, the saturated gain profiles are recalculated based upon the circulating fields in the cavity. The procedure when applied to typical unstable-resonator flowing-gain lasers shows convergence to a single distorted steady-state mode of oscillation. Typical near-field and far-field results are presented. Several empirical rules of thumb for finite truncated Hermite-Gaussian expansions, including an approximate sampling theorem, have been developed as part of the calculations. (auth)

5447 PARASITIC SUPPRESSION IN LARGE APERTURE Nd: GLASS DISK LASER AMPLIFIERS. Glaze, J. A.; Guch, S.; Trenholme, J. B. (Univ. of California, Livermore). Appl. Opt.; 13: No. 12, 2808-2811 (Dec 1974).

Threshold conditions for bulk and surface parasitic oscillations, which may limit energy storage aperture Nd/glass disk lasers, have been developed as a function of material parameters. An expression describing the energy storage distribution within a disk was used to determine the mode that will be most limiting for a particular disk design. Additional modes that may be limiting in special cases were identified and their effects evaluated. These results are useful in developing disk laser designs that minimize parasitic effects. (auth)

5448 SPECTRAL LINE SELECTION OF CARBON MONOXIDE LASERS. Rice, D. K. (Northrop Research and Technology Center, Hawthorne, CA). Appl. Opt.; 13: No. 12, 2812-2815 (Dec 1974).

An intracavity water vapor cell was used to perform spectral line selection of carbon monoxide lasers. The technique was demonstrated with a low pressure longitudinal discharge laser operating in the cw and repetitive Q-switched modes and with an electron beam stabilized pulsed laser. The cell containing an appropriate amount of water vapor limited laser action in a vibrational band to those rotational lines having predicted high atmospheric transmittance. (auth)

5449 KINETIC MODEL AND COMPUTER SIMULATION ON CONTINUOUS WAVE DF–CO_2 CHEMICAL TRANSFER LASERS. Baumann, W.; Blauer, J. A.; Zelazny, S. W.; Solomon, W. C. (Bell Aerospace Division of Textron, Buffalo). Appl. Opt.; 13: No. 12, 2823-2834 (Dec 1974).

A nonequilibrium model has been used to simulate successfully experimental data obtained on two different DF-CO_2 chemical transfer lasers. The sensitivity of the model to changes in the reaction rate constants, to mixing, and to F atom surface recombination has been investigated. The model was found to provide reasonable agreement with the known experimental facts relating to cw DF-CO_2 chain reaction laser flow fields. It was found that considerable simplification of the chemical model is possible at the sacrifice of some analytical precision. (auth)

5450 TRANSVERSE-FLOW QUASI-CW HF CHEMICAL LASER: DESIGN AND PRELIMINARY PERFORMANCE. Gagne, J. M.; Mah, S. Q.; Conturie, Y. (Univ. of Montreal). Appl. Opt.; 13: No. 12, 2835-2839 (Dec 1974).

A small transverse-flow HF chemical laser has been constructed using a large volume microwave plasma generator for the production of F atoms. The F atoms react with hydrogen to form the lasing HF molecules. The active medium is about 5 cm long, and the maximum average laser power was found to be 560 mW for all lines. Three laser lines with wavelengths 2.61 mum, 2.64 mum, and 2.73 mum were observed. The time-varying laser transition profile closely resembles the density profile of the excited fluorine atoms in the plasma. Both profiles are greatly affected by changes in flow conditions. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 5266, 5293, 5573, 6081, 6103–6108, 6121, 6123, and 6129.

5451 (CONF-750845-1) LOW TEMPERATURE MOESSBAUER THERMOMETRY. Maletta, H.; Shenoy, G. K. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-48. 5p. Dep. NTIS $4.00.

From international conference on low temperature physics LT 14; Helsinki, Finland (Aug 1975).

In Moessbauer low temperature thermometry the temperature is determined from the relative intensities of the various hyperfine lines as these are affected by the temperature dependent Boltzman populations of the hyperfine levels in the resonant nuclei. One can perform either source experiments or those that make use of the nuclear polarization in the absorber. The second method is more advisable because the radioactive heating is much smaller. The present work is concerned with a fundamental difficulty in absorber thermometry which arises from the fact that the line intensity in a Moessbauer spectrum is also dependent on the absorber thickness, the dependence on that is not a linear one. It is demonstrated that if this thickness effect is not analyzed properly, the experimental results will yield erroneous temperature values, destroying the absolute nature of the Moessbauer thermometer. (WHK)

5452 (JINR-P13-9075) REGISTRATION SYSTEM FOR SIGNALS FROM SUPERCONDUCTING QUANTUM INTERFEROMETERS. Ivanenko, A. I.; Trofimov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The system for the registration of signals from a superconducting interferometer is described. The principal electronic circuits and the characteristics of the system are given. (tr-auth)

5453 (KFK–2123) SUPERCONDUCTING SWITCH WITH IMPULSE CURRENT TRIGGERING. Koefler, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Aug 1975. 24p. (In German). Dep. NTIS (US Sales Only) $4.50.

Supplying reactive power by superconducting storage systems may have considerable advantages. The behavior and parameters of the switching device, opening and closing the storage circuit were studied. Approximate mathematical solutions were checked against measured results. The influence of the impulse capacitor was studied and hints to design the triggering circuits are given. (auth)

5454 NITROGEN-FREE HELIUM CRYOSTAT FOR SUPERCONDUCTING RESONATOR. Prentslau, N. N.; Mende, F. F.; Logvinov, V. N.; Bondarenko, I. N.; Trubitsyn, A. V. Kriog. Vak. Tekh.; No. 3, 70-73(1973). (In Russian)

The construction of a nitrogen-free helium cryostat for placement of a superconducting resonator, in which helium vapors cool the orifice and a series of screens connected to the gap, is described. The use of helium vapors for cooling the construction elements permits filling the cryostat from wide and short orifices and shortening the time of its removal from the regime. Calculational formulas are presented. The time for evaporation of helium in the 20-liter cryostat is about 5 days. (tr-auth)

5455 DESIGN OF A HIGH HOMOGENEOUS SUPERCONDUCTING LABORATORY SOLENOID. Sharma, R. G. (Inst. of Physical Problems, Moscow). Indian J. Pure Appl. Phys.; 13: No. 6, 388-390 (Jun 1975).

Details of the construction and the performance of a laboratory-size superconducting solenoid are discussed. The solenoid provides a magnetic field of over 40 kOe in a clear bore of 36 mm at a critical current value of 28.6 A. Field up to a value of 75 kOe is obtained in a narrow space (0.5 × 1 mm) by the use of a specially-designed flux concentrator. The solenoid is of a 6th order compensated-coil type, which provides a field-homogeneity of ± 0.01% in a spherical volume of 15 mm dia. At peak field, the solenoid has a stored energy of only 1.6 kJ and can, therefore, be safely operated in a glass helium dewar. (auth)

5456 STUDY OF FLOW STABILITY IN HELIUM COOLING SYSTEMS. Jones, M. C.; Peterson, R. G. (National Bureau of Standards, Boulder, CO). J. Heat Transfer; 97: No. 4, 521-527 (Nov 1975).

Methods have been developed for the computation of the frequency response and stability of helium cooling systems in the frequency range of the density wave instability. While more generally applicable, these methods were developed for a study of superconducting power transmission. Special features are the use of helium thermodynamic properties derived at every point from the exact equation of state, and the full accounting of the effect of compressibility. Classical linear control theory is employed throughout. By using a finite difference approach to the integration of the conservation equations over the space coordinate, the accuracy obtainable is limited only by the computation time available. Examples are given for representative transmission line parameters with the helium at a variety of supercritical pressures. It is concluded that, while density wave instability is a real potential problem in superconducting power transmission lines, it is not difficult to select operating parameters in a safe stable regime. (auth)

5457 ENERGY AND CRYOENGINEERING. Hammel, E. F. (Los Alamos Scientific Lab., NM). pp 11-16 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Various aspects of the energy problem are described from the standpoint of cryoengineering including energy systems, energy growth, and energy policy. An R and D taxonomy is developed which is then used to organize energy-related cryoengineering technology. Several of these technologies are discussed. (auth)

5458 HIGH-SPEED RAILWAYS IN JAPAN. Kyotani, Y. (Japanese National Railways, Tokyo). pp 17-20 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper reviews the development of conventional railways in Japan, leading up to the Shinkansen line, which at present runs at speeds up to 210 km/h, and will in the future be speeded up to 260 km/h. It then goes on to review the development of superconductive, magnetically levitated trains, which will constitute the next generation of railways, running at speeds of up to 500 km/h. (auth)

5459 SOVIET RESEARCH IN CRYOGENIC TECHNOLOGY AND APPLIED SUPERCONDUCTIVITY. Malkov, M. P.; Sytchev, V. V. pp 21-25 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper reviews the achievements of forty years of Soviet research in cryogenic technology and applied superconductivity, including air fractionation, helium liquefaction, refrigeration, superconducting magnet systems, composite conductors, dipole magnets, saddle winding magnets, electrical insulation properties, power transmission, and liquid helium storage and transmission. (auth)

5460 USE OF SUPERCONDUCTIVITY IN THE USA TRANSPORTATION PROGRAM. Borcherts, R. H. (Ford Motor Co., Dearborn, MI). pp 26-27 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

US government-sponsored programs on magnetic suspension, from the Department of Transportation and the National Science Foundation, began in 1971. However, previous work by the Ford Motor Company and the Stanford Research Institute (SRI) had demonstrated the feasibility of magnetic lift-to-drag ratios of 50–60 at 134 m/s. Current research projects include: SRI's test sled vehicle; a tracked magnetic levitation research vehicle; Magnetic Corporation of America's design study for a superconducting magnet; the linear synchronous motor; and two rotary superconducting machines, the superconducting paddlewheel and the superconducting helix. The next phase of the program will be a high-speed rocket-propelled test sled to operate on a 1 km section of guideway. (auth)

5461 SUPERCONDUCTING LEVITATED SYSTEMS: FIRST RESULTS WITH THE EXPERIMENTAL FACILITY AT ERLANGEN. Albrecht, C.; Elsel, W.; Franksen, H.; Parsch, C. P.; Wilhelm, K. (Siemens AG, Erlangen, Ger.). pp 28-34 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The electrodynamic levitation system is being investigated in Western Germany by a development group consisting of AEG, BBC, and Siemens together with Linde and other companies. A test carrier of 12 t has made the first operational runs at 55 km/h in the rolling mode. This paper reviews the technical features of the main non-cryogenic components such as track, power supply, current collector, linear induction motor, vehicle body and control center, and then describes the superconducting magnet system together with a stationary cryogenic supply facility. (auth)

5462 ON-BOARD REFRIGERATION FOR HIGH-SPEED TRAINS. Prast, G. (Philips Research Labs., Eindhoven, Netherlands). pp 35-36 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan, (7 May 1974).

The advantages and disadvantages of different refrigerator designs for use in on-board cooling systems are described. Designs in which one refrigerator is used for cooling of more than one magnet depend on a distribution system for the cold. The paper indicates a design for such a distribution system which, with one refrigerator in each car, can meet the high reliability requirements for a magnetically levitated train. (auth)

5463 ON-BOARD CRYOGENIC SYSTEM FOR MAGNETIC LEVITATION OF TRAINS: CRYOGENIC SYSTEM OF EET. Asztalos, S.; Baldus, W.; Kneuer, R.; Stephan, A. (Linde AG, Munich). pp 37-41 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

An experimental car based on electrodynamic levitation with superconducting magnets has been developed and manufactured by AEG, BBC, Siemens and other partners, together with Linde AG as the firm responsible for the on-board cryogenic system. This system has to cope with new conditions and cryogenic tasks. It can be characterized in principle by liquid helium heat exchanger units, compressors, transfer lines, rotatable and movable couplings and junctions. All transfer lines and couplings consist of three coaxial ducts for three different streams. This paper reports on processes and components. A brief description of the first results for the whole system under simulation conditions is given. (auth)

5464 MAGNEPLANE SYSTEM. Thornton, R. D.; Iwasa, Y.; Kolm, H. H. (Massachusetts Inst. of Tech., Cambridge). pp 42-45 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The magneplane is not a railroad in which magnet pads replace wheels, but a radically new transportation system conceived to make full use of the advantages offered by electrodynamic levitation. Lightweight cylindrical vehicles travel 25 cm above a lightweight aluminium trough, supported and guided by superconducting magnets extending over their entire underside. They are propelled by a synchronously travelling magnetic field generated by conductors in the guideway. Information transmitted from the vehicle to wayside power control units serves to maintain synchronism, to actively damp oscillations of the vehicle, and to maintain positive position control of all vehicles in the system. Vehicles are effectively decoupled from guideway undulations by resiliency and are free to roll into a coordinated bank angle while negotiating curves. (auth)

5465 HIGH-SPEED MAGLEV STUDIES IN CANADA. Atherton, D. L.; Eastham, A. R. (Queen's Univ., Kingston, Ont.). pp 46-50 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper reports on Canadian studies of superconducting magnetic levitation and variable-speed linear synchronous motor propulsion for high-speed inter-city guided ground transport. Levitation is obtained by the interaction of vehicle-mounted superconducting magnets and the eddy currents induced in aluminium strip conductors on the guideway. Non-contact propulsion

by linear synchronous motor (LSM) is obtained by using vehicle-borne superconducting magnets and powered guideway coils. A suggested guidance scheme uses a flat guideway with "null-flux" loops overlying the LSM windings. The propulsion magnets interact with the loops and the edges of the levitation strips to provide lateral stabilization. The test facility is a 7.6 m wheel, rotating with a peripheral speed of 33 m/s. (auth)

5466 SUPERCONDUCTING POWER TRANSMISSION PROGRAMS IN THE USA. Belanger, B. C. (Atomic Energy Commission, Washington, DC). pp 51-53 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

In the United States there are currently four laboratory programs specifically devoted to superconducting transmission. Additional supporting research is underway at other laboratories. This review paper describes the organization of these programs and summarizes recent technical accomplishments. (auth)

5467 CRYOPOWER TRANSMISSION STUDIES IN EUROPE. Bogner, G. (Siemens AG, Erlangen, Ger.). pp 54-63 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

European studies on cryopower transmission are focused on semiflexible and totally flexible superconducting cables. Intense investigations of cable components are being performed. Nb/Cu and Nb/Al composite conductors have been developed, which exhibit 50 Hz surface losses well below the design limit of a.c. cables at 4 to 6°K and surface peak flux densities up to 0.1 T. Measurements of breakdown voltages and dissipation factors at 4°K indicate that wrapped tape electrical insulation, impregnated with He, may be suitable for superconducting cables, the achievable dielectrical strength being about 10 kV/mm (rms). But further investigations are necessary within this topic. Different types of d.c. and a.c. cable joint and terminal have been designed or already constructed. A number of larger laboratory model tests with cable sections up to 50 m length have been performed or are planned for the near future with the aim of studying size effects, the interaction of different components and to demonstrate the feasibility and performance of superconducting cables. (auth)

5468 PRESENT STATE OF R AND D FOR SUPERCONDUCTING TRANSMISSION IN JAPAN. Horigome, T. (Electrotechnical Lab., Tokyo). pp 64-67 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The advantages of superconducting cables for large-scale, long-distance power transmission have been widely recognized. However, there is a need for much costly research into the scientific and engineering problems before superconducting cables can be incorporated in the power network. This paper outlines the current state of R & D in Japan on superconducting transmission. The immediate aim is a 10 GW cable that can handle 500 kV ac, or ±200 kV dc. (auth)

5469 SYSTEM ASPECTS OF CRYOGENIC ELECTRIC POWER TRANSMISSION. Nicol, J. (Arthur D. Little, Inc., Cambridge, MA). pp 68-70 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Three years ago, the development of cryogenic power transmission systems was concentrated on proving technical feasibility. Today, the emphasis has changed to the development of systems that meet the technical, economic and operating requirements of the electric utility industry. This paper discusses the areas in which technical development is required if cryogenic systems are, one day, to enter utility service. (auth)

5470 SUPERCONDUCTING MAGNETIC ENERGY STORAGE. Laquer, H. L. (Los Alamos Scientific Lab., NM). pp 71-77 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

After a brief review of the reasons for and forms of secondary energy storage and of the elements and history of inductive or magnetic storage, we discuss the four regions in which superconducting magnetic energy storage can be applied. Differences in energy transfer times place different requirements on the storage coil, on the switch and on the energy losses in the superconductor. We report on designs and experiments in one of these areas with 2 to 300 kJ units, and on the analysis and plans for an installation that is to provide 250 MJ of plasma compression energy for the theta-pinch controlled thermonuclear fusion physics test reactor. We point out those elements of inductive storage that need further development before a theta-pinch fusion reactor can become economically competitive. Finally, we compare the size and costs of the energy storage components of these systems with similar and with larger inductive storage systems that are to interact reversibly with electric utility networks. (auth)

5471 COMBINED SYSTEM FOR PROPULSION AND GUIDANCE OF MAGNETICALLY SUSPENDED VEHICLES. Takahashi, T.; Maki, N.; Miyashita, T. (Hitachi Ltd., Ibaraki, Japan). pp 78-81 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A combined system for propulsion and guidance of magnetically suspended vehicles is proposed, with theory and calculation results. In this system, a track coil arranged in the null-flux configuration is used as an LSM armature coil. This system is economical and reliable because the same track coil is utilized both for propulsion and for guidance, and a guidance force is maintained even if power failure occurs. (auth)

5472 SUPERCONDUCTING MAGNET FOR ML-100. Kasahara, T. (Hitachi Ltd., Ibaraki, Japan); Saito, R.; Kazawa, Y.; Tada, N.; Takahashi, T.; Kimura, H.; Sato, S. pp 82-85 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A superconducting magnet for magnetic suspension of a vehicle has been developed and tested. The magnet contains two superconducting coils of 250 kAT per coil wound with a fine multifilamentary superconducting composite, Hisuper 271Z FMB (Nb-Ti-Zr). The magnet is thermally insulated by high vacuum and the radiation shield is cooled with helium vapor. In operation tests, the superconducting magnet has showed the stable performance required to lift the vehicle. (auth)

5473 DESIGN CONSIDERATIONS FOR SUPERCONDUCTING MAGNETS AS A MAGLEV PAD. Ichikawa, H.; Ogiwara, H. (Tokyo Shibaura Electric Co. Ltd.). pp 86-89 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The design and construction of a thin superconducting magnet for a magnetically suspended high-speed train are explained. The superconducting magnet, which is to be used in a null-flux maglev train system, is called a "wing-type" superconducting magnet because of its geometry. The wing-type superconducting magnet is about 1.5 m long and weighs about 500 kg, but its heat loss is within 1 W, which is very small compared with that of conventional superconducting magnets. (auth)

5474 DEVELOPMENT OF SUPERCONDUCTING MAGNETS FOR MAGNETICALLY LEVITATED TRAINS. Ohno, E.; Iwamoto, M.; Ogino, O.; Kawamura, T. (Mitsubishi Electric Corp., Amagasaki, Japan). pp 90-93 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Superconducting magnets will play a vital role in magnetically levitated trains, producing lift, guidance and propulsion forces. The main problems in the design are the current density of coils and the cryogenic thermal insulation. This paper describes the development of full-scale levitation magnets with length of 1.55 m and width of 0.3 or 0.5 m. Dynamic levitation tests using small model magnets are also presented. (auth)

5475 DEVELOPMENT OF SUPERCONDUCTING MAGNETS FOR A MAGNETICALLY SUSPENDED HIGH-SPEED TRAIN IN TOSHIBA. Ogiwara, H.; Takano, N. (Tokyo Shibaura Electric Co. Ltd.). pp 94-96 of Proceedings of the Fifth International

Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

There are many important features of the superconducting magnets used for a magnetically suspended high-speed train: the a.c. components of the field; the electromagnetic forces acting on the coil; the shape and structure of the cryostat fitting to the space under the vehicle; the inner compositions of the cryostat for insulating the heat inflow and transferring lift and propulsive forces; the function of the superconducting magnet as a component of the on-board cryogenic system; and so on. A three-year project, begun in April 1971, has been carried out in order to study and establish the design and manufacturing techniques for the superconducting magnet, the cryostat, and the refrigeration system. (auth)

5476 VERTICAL CRYOSTAT FOR GUIDANCE AND PROPULSION OF SUPERCONDUCTING MAGNETIC LEVITATION VEHICLE. Nakashima, H.; Arima, K. (Japanese National Railways, Tokyo). pp 97-98 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The superconducting magnetic levitation vehicle requires two types of magnet: one for levitation, and one for guidance and propulsion (linear synchronous motor). The magnet for levitation is mounted horizontally on the vehicle, and the other vertically; so the cryostats for these magnets are divided into two types, when one cryostat is used for each magnet. These on-board cryostats have to satisfy three fundamental conditions: lightness; small heat leak; and enough strength to ensure the electromagnetic forces. A prototype vertical cryostat was designed for research into on-board cryostats for guidance and propulsion. A small refrigerator can be connected to the cryostat, to facilitate testing of the fundamental refrigeration system on board. The performance of the cryostat and the test results are reported. (auth)

5477 REFRIGERATION SYSTEM FOR MAGNETICALLY LEVITATED TRAINS. Arima, K.; Nakashima, H.; Kuzuu, T. (Japanese National Railways, Tokyo). pp 99-101 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A central problem in developing a superconducting magnetically levitated train is cooling the magnets. It is no exaggeration to say that the cooling system is the key to the success of the project. There are two basic methods of cooling: on-board helium gas storage with on-ground liquefaction, and on-board refrigeration. The various versions of on-board refrigeration include one refrigerator per train, one refrigerator per car, one refrigerator per cryostat, and various intermediate versions. After study, our opinion is that on-board refrigeration is the more suitable for practical use, and in particular the one-refrigerator-per-car and one-refrigerator-per-cryostat versions. It will be possible to make the on-board weight less than 2 tons/car. (auth)

5478 SEALED CRYOSTAT SYSTEM FOR MAGNETICALLY LEVITATED VEHICLES. Ishizaki, Y. (Tokyo Univ.); Kuroda, T.; Ohtsuka, T. pp 102-105 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper describes a sealed-off cryostat for on-board refrigeration in magnetically levitated vehicles. There are problems still to be studied, such as the stability of superconducting magnets under non-isothermal and pressurized conditions. If these prove to be non-critical, then the system appears to offer attractive features both in efficient utilization of the heat in the refrigerant and in adding redundancy and acting as a buffer system for more conventional systems. (auth)

5479 CHARACTERISTICS OF THE RIDE QUALITY OF SUPERCONDUCTING MAGNETIC LEVITATION TEST VEHICLE. Iwahana, T.; Kuzuu, T. (Japanese National Railways, Tokyo). pp 106-107 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The experimental results of oscillatory acceleration due to the motion of the superconducting magnetic levitation test vehicle will be discussed in comparison with theoretical values and the coefficients of ride quality which are used now in Sinkansen. The ride quality of the levitating vehicle was generally good and agreed approximately with calculated values. (auth)

5480 PRELIMINARY MEASUREMENT OF 2 e/h BY THE JOSEPHSON EFFECT. Endo, T.; Koyanagi, M.; Koga, S.; Yonezaki, G.; Nakamura, A. (Electrotechnical Lab., Tokyo). pp 108-111 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Measurement of 2e/h has been done by using the Josephson effect. The obtained result is $2e/h = 483\,594.31 \pm 0.13$ GHz/V_{ETL74} (0.27 ppm). The value agrees well with results by several national laboratories when one takes into account the international comparison of the national voltage standards in 1973. (auth)

5481 MACROSCOPIC DERIVATION OF THE MAXIMUM JOSEPHSON TUNNELING CURRENT DENSITY. Sommerhalder, R.; Drangeid, K. E.; Baechtold, W. (IBM Research Lab., Zurich). pp 112-113 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

By the Josephson effect, we understand tunnelling between superconductors partitioned by extremely thin barriers of substances which in bulk are not superconducting; for instance, dielectrics. Josephson tunnelling is hard to conceive intuitively, because it cannot be explained in classical terms. On the other hand, there is an ever-growing interest in it, and therefore a need for simple procedures to give some insight to non-specialists. The aim of this paper is to derive an expression for the maximum d.c. Josephson current density i_j flowing between identical superconducting metals, which is based on phenomenological considerations alone. Although it is not rigorous, the procedure is good enough to make the fact intuitively conceivable that between superconductors a d.c. tunnelling current without a voltage across the junction may set up, and on what parameters it depends. (auth)

5482 THIN-FILM SQUIDS AND THEIR APPLICATIONS. Albrecht, G.; Richter, W. (Univ., Jena, Ger.). pp 119-120 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper describes superconducting quantum interference devices (SQUIDs) fabricated by thin-film techniques. Applications of the devices include their use as galvanometers for measuring voltages in the range 10^{-7}–10^{-15}V, and for measurement of the susceptibility of very small samples, e.g., V_3Si whiskers with masses of $\sim 10^{-5}$ g. (auth)

5483 PROPERTIES OF TUNNEL JUNCTIONS WITH NIOBIUM AND VANADIUM BASE FILMS. Albrecht, G.; Bluethner, K.; Dettmann, F.; Pertsch, P. (Univ., Jena, Ger.). pp 121-123 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The properties of tunnel junctions using niobium and vanadium base films prepared either in high or in ultrahigh vacuum are compared. (auth)

5484 AC LOSSES OF NORMAL METALS IN SUPERCONDUCTING CLAD WIRES. Irie, F. (Kyushu Univ., Fukuoka); Funaki, K.; Takeo, M. pp 124-128 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The a.c. losses of a normal conductor in a composite superconducting wire with a single superconducting core are calculated. The obtained formula contains terms with higher power than the square of the applied field, while existing theories show the field dependence of the square. Comparison of the formula with existing experiments shows good agreement. (auth)

5485 AC LOSSES OF Nb–Ti SUPERCONDUCTING WIRE WITH HOLLOW CYLINDRICAL SHAPE IN LONGITUDINAL DC FIELDS. Nakayama, Y.; Koike, Y.; Toyoda, T. (Tokyo Shibaura Electric Co. Ltd.). pp 129-131 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K.

(ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The hollow cylindrical conductors were fabricated by simultaneous cold drawing of Nb–Ti pipes and OFHC cores inside. A.c. losses of these conductors were reduced when d.c. longitudinal fields were applied to them. The absence of the central parts of the conductors had no effect on the a.c. loss behavior, and the a.c. flux penetration decreased as the longitudinal d.c. fields increased. From these results, the reduction of the flux penetration depth and the strong pinning surface layer were discussed. (auth)

5486 AC LOSSES OF A SUPERCONDUCTING WIRE IN A LONGITUDINAL MAGNETIC FIELD. Yamafuji, K. (Kyushu Univ., Fukuoka). pp 132-134 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Low-frequency a.c. losses in a wire of a non-ideal type II superconductor in the presence of a longitudinal magnetic field are discussed theoretically with the aid of the critical-state model. It is shown that the proposed force-balance equation results in a good qualitative agreement with existing observed data of a.c. losses. (auth)

5487 HIGH-SPEED SUPERCONDUCTING GENERATOR. Blaugher, R. B. (Westinghouse Research Labs., Pittsburgh); Fagan, T. J.; Parker, J. H. Jr.; Wells, J.; McCabria, J. L. pp 143-148 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper reviews the overall cryogenic and mechanical design and final test results of the prototype 12,000 rev/min 4-pole superconducting rotor developed for the USAF. Some of the important mechanical details relating to superconducting coil construction, rotor fabrication, welding, and overall rotor assembly are discussed. The cryogenic cooling scheme, thermal load, He transfer system, and overall instrumentation are presented. Finally, the actual running tests are to be reviewed which includes: warm and cold spin-up to 12,000 rev/min, overspeed tests, and successful field excitation (at 12,000 rev/min) to an equivalent 5 MVA power rating. (auth)

5488 SUPERCONDUCTING PROPULSION SYSTEMS. Appleton, A. D. (International Research and Development Co. Ltd., Newcastle upon Tyne, Eng.); Bolshaw, S. pp 149-153 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Marine propulsion is emerging as one of the principal applications for superconducting dc machines. This paper describes the program for application of this technology, and the world's first superconducting dc propulsion system. The potential advantages of such a propulsion system include flexibility and economy in ship layout; increased propeller efficiency; and improved maneuverability. (auth)

5489 SUPERCONDUCTIVE dc GENERATOR. Yamamoto, M.; Yamaguchi, M. (Tokyo Shibaura Electric Co. Ltd.). pp 154-156 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper describes a superconductive homopolar generator that has been developed; it is rated at 3000 kW, 20 kA and 150 V at 1000 rev/min and 4.5 T, produced by a superconductive coil of 1.6 m bore. Feasible outputs, given present manufacturing techniques, seem to be 50 to 150 MW with a terminal voltage of 500 to 750 V. In the future, it should be possible to achieve an output of 500 MW, 1000 V and 500 kA. (auth)

5490 SUPERCONDUCTING ELECTRICAL GENERATORS FOR CENTRAL POWER STATION USE. Birmingham, B. W.; Chelton, D. B.; Flynn, T. M.; Powell, R. L. (National Bureau of Standards, Boulder, CO). pp 157-159 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The superconducting electrical generator will be a major step in meeting future power needs. Although it will require a considerable tranfer of technology, there do not appear to be any fundamental technical barriers. Among the potential advantages are increased generator rating, improved efficiency, reduced transportation and site erection problems, and reduced cost. The economic cross-over between superconducting and normal generators appears to be around 1500 MVA, but as the technology develops, superconducting techniques will no doubt be applied to much smaller machines. (auth)

5491 MAIN PROBLEMS MET IN THE STUDY OF CRYOGENIC GENERATORS. Ruelle, G. (Alsthom Co., Belfort, France). pp 160-163 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

There is general agreement worldwide on the basic structure of cryogenic generators, with a hot stator and a rotor with superconducting field winding at very low temperature (4 to 5°K). The main problems arising from cryogenic generator development especially concern the rotor: the problem of the electromagnetic and mechanical behavior of the shield required for protecting the superconductor against the induction changes faced with any possible disturbances; the problem of the superconductor and cooling helium system behavior faced with the particular conditions of a cryogenic generator; the problem of structural materials; technological problems arising from helium admission in the rotor. At the present state of studies, one can positively put forward that the cryogenic generator is feasible. Its competitiveness is not ensured with respect to conventional generators. It is obvious that its chances of development could be largely increased if a certain number of parallel researches succeeded in the following fields: development of superconductors having a higher critical temperature; development of structural materials, metallic, and non-metallic; dropping of refrigerator costs and reliability increasing. (auth)

5492 CONDUCTOR TESTS FOR DC SUPERCONDUCTING POWER TRANSMISSION. Bartlett, R. J.; Hammel, E. F.; Hoffer, J. K.; Keller, W. E.; Kerr, E. C.; McDonald, T. E.; Taylor, R. D.; Trela, W. J. (Los Alamos Scientific Lab., NM). pp 174-176 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The cryogenic and electrical aspects of a new program to evaluate superconductors suitable for a dc superconducting power transmission line are presented. Short sample tests at 4°K at currents up to 39 kA and test-bed operation up to 10 kA are described. (auth)

5493 SUPERCONDUCTING CABLE TEST FACILITY. Baylis, J. A.; Lewis, K. G.; Meats, R. J.; Noe, J. A. (Central Electricity Generating Board, Southampton, Eng.). pp 177-179 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A facility for testing short samples of superconducting cable has been built at the Central Electricity Research Laboratories of the CEGB, England. Cable samples, up to 5.5 m in length, can be tested with continuous current up to 10 kA, and simulated short-circuit currents up to 70 kA, or with continuous voltage up to 110 kV and impulse voltages up to 300 kV. Samples are cooled by a closed cycle flow of helium gas from a 150 W refrigerator. The facility has been used to measure ac losses in a pair of large composite tubular conductors. (auth)

5494 ELECTRICAL TESTS ON A SUPERCONDUCTING MODEL CABLE. Furuto, Y.; Miura, T.; Ikeda, M.; Inoue, I. (Furukawa Electric Co. Ltd., Tokyo). pp 180-183 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The paper describes three designed model cables, and a basic electrical test on a model cable, which is the first of its kind in Japan. The electrical test was performed on a model cable 4 m long. Electrification was made up to 3000 A ac and 5000 A dc. It was confirmed that the core had an equivalent critical current of 11,000 A. Consumption of liquid helium was about 20 l/h at the current load of 5000 A. Simultaneously with the test in question, a test was made of a superconductive transformer

consisting of a silicon steel core, 300 turns coils of NbTi wire for the primary and simulated cable for the secondary. (auth)

5495 THERMAL INSULATION TESTS FOR A SUPERCONDUCTING MODEL CABLE. Higuchi, N.; Natori, N.; Sekine, S.; Itoh, N. (Electrotechnical Lab., Tokyo). pp 184-186 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

In order to develop the superconducting cable system, effective but economical thermal insulation is one of the most important problems. Then using the horizontal type cryostat thermal insulation characteristic tests were carried out for some type of thermal insulator. The vacuum insulation and multilayer insulations were examined. (auth)

5496 COST COMPARISON OF SUPERCONDUCTING CABLES AND HYDROGEN PIPELINES FOR ENERGY TRANSPORTATION. Ihara, S. (Electrotechnical Lab., Tokyo). pp 187-192 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A parametric study of energy cost of a hydrogen-electric utility system has been made with special reference to the new energy transmission technologies which are superconducting cable, hydrogen gas pipeline, superconducting cable and parallel hydrogen gas pipeline, and superconducting cable concentric with liquid hydrogen pipeline. It is shown that the energy transmission of the third type renders the lowest energy cost. (auth)

5497 THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF CRYORESISTIVE UNDERGROUND POWER TRANSMISSION. Heller, I. (Kernforschungsanlage, Juelich, Ger.); Hofmann, A.; Komarek, P. pp 193-197 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A primary study shows that various LN_2-cooled cryoresistive cables can meet the requirements for the European congestion areas for the next 30 yr. In the power range above 1000 MVA cryogenic cables promise to be competitive with conventional cables. The most uncertain factors of this calculation have been analysed more exactly by some theoretical and experimental investigations. It is shown that no reduction of power transport costs can be expected by decreasing the cable temperature below LN_2 range. The ac losses caused by eddy currents have been measured at LN_2 temperature for different types of cable model. Some experiments on thermal insulation prove that the vacuum needed for sufficient shielding can be maintained for the assumed lifetime of a cable without pumps just by the use of adsorbers (zeolith) placed between cold wall and superinsulation. Based on these results a final comparison with room temperature cables with forced cooling in the conductor proves that no great economical advantage of a cryoresistive cable can be expected at present. (auth)

5498 THERMAL PERFORMANCE OF AN LNG-COOLED POWER TRANSMISSION LINE. O'Farrell, P. M. (Arthur D. Little, Inc., Cambridge, MA); Cravalho, E. G.; Toscano, W. M. pp 198-205 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The present work evaluates the thermal performance of a total energy transmission system using subcooled liquefied natural gas (LNG) as the refrigerant in a cryogenic resistive cable. Thermodynamic and transport properties of the LNG are approximated by those of methane. The behavior of the cable is described by a system of partial differential equations coupled via the rate equations for heat transfer between the conductors and the LNG. Steady-state temperature and pressure profiles along a 10 km cable length are developed for three current ratings for various LNG flow rates. Energy distribution varies from 24% to 67% thermal based on a mean heating value for the LNG. Refrigeration and pumping requirements are presented for the steady state. Transient thermal response of the cable is evaluated for step increases in current. (auth)

5499 DEVELOPMENT OF A HIGH VOLTAGE CRYORESISTIVE CABLE. Iwata, Z.; Nobuta, S.; Nakajima, M.; Matsumoto, K.; Kikuchi, K. (Furukawa Electric Co. Ltd., Yokohama, Japan). pp 206-213 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The outline of the development of extra-high voltage cryoresistive cable cooled with liquid nitrogen is reported. Designing of the cryoresistive cable is discussed based on the experimental data, such as the electrical insulation at low temperature and ac resistance of conductor. The extra-high voltage three-phase model developed is 20 m in length and is accompanied with a cooling system which can circulate sub-cooled liquid nitrogen. This model is operated continuously for one week under the current rating of 5000 A. Electrical properties of the 154 kV cryogenic cable are satisfactory. Application of LNG to the cooling system is proposed with the discussion of the capital cost and the cooling energy ratio. (auth)

5500 DEVELOPMENT OF A 154 kV CRYORESISTIVE CABLE. Kubo, I.; Yamada, O.; Shiseki, N. (Fujikura Cable Works Ltd., Tokyo). pp 214-220 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper details the experimental test results for a 154 kV cryoresistive model cable which we have recently developed. It deals with the following items: fundamental tests in the development of a cryoresistive cable; ac withstand voltage, lightning impulse voltage tests of a model cable and its pothead; current loading test for a 154 kV class pothead; thermal contraction test of a model cable line. The ac breakdown stress is only a little less than that of oil impregnated kraft paper cables, but breakdown stress with lightning impulses is lower than oil-impregnated kraft paper cable. It has been confirmed that the pothead has ample current capacity and sufficient voltage strength for use with the 154 kV class of cryoresistive cable. (auth)

5501 DISCHARGE PHENOMENA IN POWER CABLE INSULATION AT LIQUID NITROGEN TEMPERATURES. Tanaka, T.; Okamoto, H. (Central Research Inst. of Electric Power Industry, Tokyo). pp 221-223 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Internal discharge phenomena have qualitatively been clarified for polyethylene insulation with a cavity filled with liquid nitrogen. Temporal change in discharge magnitude depends on the sealing degree of the cavity, which is closely related to the state of bubble formation in liquid nitrogen. The increase in pressure would suppress the bubble formation and accordingly the occurrence of the discharges. The decrease in pressure, however, gives a serious effect on insulation by the rapid start of discharges due to boiling of liquid nitrogen. Polyethylene films are somewhat resistant to internal discharges, but spun-bonded polyethylene paper breaks down easily when it is subjected even to small discharges. (auth)

5502 DETERIORATION OF INSULATING PLASTICS BY PARTIAL DISCHARGE IN LIQUID NITROGEN. Takahashi, Y. (Chuo Univ., Tokyo). pp 224-228 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Two types of discharge are observed with a rod-plane electrode system, a weak discharge at the edge of the rod and a noisy creeping discharge accompanied with bubbling. At high impressed voltage, the latter type is predominant. It has been confirmed that the discharge in LN_2 can be studied by Lichtenberg's figure. Dependence of deterioration life T of polyethylene film on the impressed ac voltage V varies as $T \propto V^{-1}$. Therefore, the partial discharge is very dangerous for insulations in LN_2. Deterioration lives of the other plastics are much smaller than that of polyethylene. (auth)

5503 A MILLIKELVIN DILUTION REFRIGERATOR WITH PLASTIC EXCHANGERS. Frossati, G.; Thoulouze, D. (CNRS, Grenoble, France). pp 229-231 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

It is now easy to produce temperatures of the order of 20 to 30 mK with very simple dilution refrigerators, but it is possible to reach much lower temperatures in the mK range by taking into account more carefully the parameters involved in the process. We describe the low-temperature part of a refrigerator allowing us to perform experiments down to 5.8 mK in a permanent mode, as well as the different arrangements which led to the final form. (auth)

5504 ^{4}He EVAPORATION HEAT EXCHANGERS FOR A ^{3}He/^{4}He DILUTION REFRIGERATOR. Saito, S.; Mine, S.; Sato, T. (Tohoku Univ., Sendai). pp 232-234 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Two types of ^{4}He evaporation heat exchangers are described. A minimum temperature of 1.18°K was attained with a flow impedance of the order of 10^{11} cm^{-3}. The orifice at the pumping line and the additional buffer volume in the exchanger were effective for stabilization of the exchanger temperature and for short term overloads, while the temperature of the exchanger with orifice remained relatively higher than that without orifice. (auth)

5505 EXPERIMENTS WITH MINIATURE HEAT EXCHANGERS FOR DILUTION REFRIGERATORS. Radebaugh, R. (National Bureau of Standards, Boulder, CO); Siegwarth, J. D.; Oda, Y.; Nagano, H. pp 235-237 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Experiments done on three types of miniature heat exchanger for dilution refrigerators are described. These have liquid volumes on the order of 0.1 cm^3. The first is a continuous exchanger incorporating Cu(Cr) powder, the second is a continuous exchanger incorporating sub-micron silver powder, and the third is a discrete exchanger incorporating 1.8 μm copper powder. The first two were not successful and the reasons are not entirely clear. The third exchanger performed about as calculated and permits an order of magnitude reduction in liquid volumes from that normally used. (auth)

5506 SELF-CONTAINED REFRIGERATOR FOR TEMPERATURES TO 0.25 K. Daunt, J. G.; Lerner, E. (Stevens Inst. of Tech., Hoboken, NJ). pp 238-239 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A refrigerator has been designed, constructed and operated, which by use of three refrigerative subsystems operating in cascade maintains temperatures down to 0.25°K without the use of externally supplied liquid helium. A description of the construction of the refrigerator is given, with details of dimensions of key components and quantitative information on its performance. (auth)

5507 APPLICATION OF A CHARCOAL-PUMPED ^{3}He CRYOSTAT TO A FAR INFRARED DETECTOR. Yamamoto, J. (Osaka Univ.). pp 240-241 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A conventional charcoal-pumped liquid ^{3}He cryostat is applied to a far infrared detector. ^{3}He gas can be sealed off in the cryostat. The cryostat has no moving part which frequently causes a ^{3}He gas leak. The system can keep temperatures about 0.4°K for 5 hours with 1 liter (at STP) of ^{3}He gas. The combination of the cryostat and an InSb detector shows improved responsivity in the far infrared region due to the extremely low temperature and lack of mechanical vibrations. (auth)

5508 SOME TRIALS FOR NOVEL HEAT EXCHANGERS FOR A DILUTION REFRIGERATOR. Oda, Y.; Nagano, H. (Tokyo Univ.). pp 250-252 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Experimental results done on two kinds of simple heat exchanger for a dilution refrigerator are described. The first is a usual continuous heat exchanger of CuNi tubes but with two stages to achieve a large surface area. The second is a discrete heat exchanger with pressed Cu sponges instead of sintered ones. The geometry of the second is improved to reduce the thermal conductance of the liquid along the flow direction. Both performed about as calculated and have merits in simplification and in reduction of liquid volume. (auth)

5509 THERMOMETRIC CHARACTERISTICS OF SOME 1/8 W CARBON RESISTORS IN THE MILLIKELVIN RANGE. Radebaugh, R.; Holste, J. C.; Siegwarth, J. D. (National Bureau of Standards, Boulder, CO). pp 253-255 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Gotoh and Awano have reported on the useful characteristics of 1/8 W 100 OMEGA Matsushita carbon resistors (grade ERC-18GK) as thermometers for the region 0.4°K and 4.2°K. Measurements on the resistance characteristics of this grade of resistors from 11°mK to 1°K are reported. Nominal resistances of 56 OMEGA, 68 OMEGA, 82 OMEGA, 100 OMEGA, and 220 OMEGA were measured. It was found that the 56 OMEGA, 68 OMEGA, and 82 OMEGA resistors make useful thermometers down to at least 11°mK. A comparison of the resistance behavior of units immersed in dilute ^{3}He-^{4}He with those outside the liquid was also made. (auth)

5510 FUTURE OF SUPERCONDUCTING TECHNOLOGY. Kolm, H. H. Massachusetts Inst. of Tech., Cambridge). pp 256-257 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

As soon as cryogenic engineering problems are convincingly solved, superconducting technology is destined to play a vital role in mining, pollution control, medicine, power generation and transmission, and metallurgy. (auth)

5511 DESIGN AND OPERATION OF A REFRIGERATOR SYSTEM USING SUPERFLUID HELIUM. Claudet, G. (CEN, Grenoble, France); Lacaze, A.; Roubeau, P.; Verdier, J. pp 265-267 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Conventional methods for obtaining superfluid helium for refrigeration involve large flow pumps, large-necked cryostats, risks of air-leaks, and difficulties in refilling with liquid helium. Alternative systems have been proposed in which an independent refrigeration system at the bottom of the bath is used to obtain superfluid helium at normal pressure, so that a layer of normal helium (a very poor heat conductor) remains on the top of the cryostat. This has the disadvantage that it only permits bath temperatures near the λ transition temperature, where heat transfer is limited. This paper describes a new design of refrigerator which makes possible bath temperatures sufficiently below Tλ to give good heat transfer. (auth)

5512 SUPERCONDUCTIVE COMMUNICATION TRANSMISSION. Hoshiko, Y. (Musashino Electrical Communication Lab., Tokyo). pp 282-288 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Recent developments in superconducting techniques have made possible the application of superconductivity in communication cables. Extensive studies have been made, and several experimental coaxial lines and superconductive communication cables have been produced and tested. The attenuation and transmission capacities of superconductive coaxial lines are exceedingly improved compared with existing cables. Furthermore, the cost per unit information rate of superconductive communication cables is far less than that of existing cables. (auth)

5513 SUPERCONDUCTING COAXIAL CABLE AS A LARGE CAPACITY TRANSMISSION MEDIUM FOR COMMUNICATION. Mikoshiba, K.; Shimohori, Y.; Ohmori, N.; Sone, F. (Hitachi Cable Ltd., Tokyo). pp 289-292 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

In order to survey the feasibility of the superconducting communication system, the electrical performance of superconducting coaxial cable has been investigated experimentally. The results are as follows. The transmission loss can be described as a function of the frequency, $a(f) = a_1 f^2 + a_2 f$. Dielectric loss is dominant up to a few gigahertz. Improvement of the impedance irregularities due to dimensional imperfections along the cable smoothens the transmission loss versus frequency characteristics. The temperature dependence of the transmission loss agrees considerably with an approximate expression deduced from the Pippard temperature function to the neighborhood of the critical temperature of the superconductor applied. (auth)

5514 RESEARCH ON SUPERCONDUCTING MAGNET SYSTEM FOR MHD PROJECT IN JAPAN. Aiyama, Y. (Electrotechnical Lab., Tokyo). pp 296-299 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Research on the superconducting magnet system for the MHD project in Japan is reviewed and the ETL Mark V MHD generator with a large superconducting magnet is described. On the basis of this research, the general design of a superconducting saddle magnet for a practical MHD plant is proposed. (auth)

5515 LARGE SUPERCONDUCTING MHD MAGNET. Aiyama, Y. (Electrotechnical Lab., Tokyo); Fushimi, K.; Yasukochi, K.; Kasahara, T.; Saito, R.; Tada, N.; Kimura, H.; Sato, S. pp 300-303 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A large superconducting magnet for a 1000 kW class MHD power generation system has been constructed. Design criteria, characteristics, construction and test experiment are descibed. The magnet is vertical with a race-track shape coil and has features of large magnetic stored energy, high maximum magnetic field on the conductor, and large electromagnetic forces. The magnet was successfully tested and the central magnetic field attained 45.5 kG with a stored magnetic field of 60 MJ. The quick elimination of the magnetic stored energy was also done with satisfactory result. (auth)

5516 HELIUM REFRIGERATOR-LIQUEFIER SYSTEM FOR MHD GENERATOR. Akiyama, Y. (Electrotechnical Lab., Tokyo); Ishii, H.; Mori, Y.; Yamamoto, M.; Wada, R.; Ando, M. pp 304-307 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

MHD power generators have been investigated in the Electrotechnical Laboratory as one of the National Research and Development Programmes. A helium refrigerator-liquefier system has been developed to cool the superconducting magnet for a 1000 kW class MHD power generator. The turbo-expander with low temperature gas bearings and an alternator had been developed for MHD project at the Electrotechnical Laboratory previously. The liquefaction capacity is 250 l/h and the refrigeration power is 2.9 kW at 20 K. The superconducting magnet is 50 tons and the cryostat has a liquid helium volume of 2700 l. The evaporation rate is 60 to 80 l/h. It takes, in all, 2 to 3 weeks until the cryostat is filled with liquid helium of 2700 l. (auth)

5517 SUPERCONDUCTING SYNCHRONOUS MACHINE. Akiyama, S.; Fujino, H.; Ishihara, A.; Ueda, K. (Fuji Electric Co. Ltd., Nagasaki). pp 308-311 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A synchronous generator with stationary superconducting field coils was made and tested in order to investigate the electrical-features of such a machine. The machine has four-pole field windings outside a rotating armature with horizontal axis. The induced voltage and the short-circuit current increase linearly with the field current and are not saturated. Various reactances were measured with short-circuit test, the Dalton-Cameron method and the dc decay method. The synchronous reactance is very small as compared with conventional machines. This means that superconducting machines are superior in steady-state stability. In the sudden short-circuit tests, visible variations of the field current and the d.c. component of the armature current were not observed. Synchronous operation of the machine was performed with connection to the commercial distribution network and a sharp V-curve and other characteristics have been obtained. (auth)

5518 DESIGN AND TESTING OF A 10 kVA SUPERCONDUCTING SYNCHRONOUS MACHINE. Ushio, K.; Kaiho, K.; Nomura, H.; Hayakawa, T.; Todoriki, I. (Electrotechnical Lab., Tokyo). pp 312-315 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A 10 kVA generator was constructed and tested for the purpose of investigating the performance of superconducting synchronous machines. The machine has an inner rotating field winding and a verticle spindle. The design of the field winding, the construction of the machine and the results of test at no load operation are reported. (auth)

5519 SUPERCONDUCTING AIRBORNE MINERAL DETECTION SYSTEM. Vogen, W.; Clawson, B. (Univ. of California, Berkeley). pp 316-318 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The concept, design and construction of a superconducting geophysical exploration device which yields a ground conductivity map, has required the development of novel ac superconducting coils and non-metallic liquid helium cryostats. Ac losses in the flight coils were predicted by testing small solenoids which had similar fields and current levels. Large electrically nonconducting cryostats were required to prevent electromagnetic coupling between the ac coils and the liquid helium cryostat. (auth)

5520 SUPERCONDUCTING LENSES FOR ELECTRON MICROSCOPY. Dietrich, I. (Siemens AG, Munich). pp 319-321 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

After discussing the advantages of superconducting lenses the different lens types are described: plain superconducting coils, iron core arrangements, superconducting rings with trapped flux and shielding lenses. Measurements of the field distribution in all these lenses have been carried out and the theoretical aberration coefficients calculated. A number of devices were tested in microscopes with beam voltages up to 400 kV. With the shielding lens, a point resolution below 5 Å and a lattice resolution of 3.4 Å could be demonstrated. (auth)

5521 V_3Ga STRANDED WIRE WOUND SUPERCONDUCTING MAGNET. Ikeda, M.; Furuto, Y.; Tanaka, Y.; Inoue, I.; Ban, M. (Furukawa Electric Co., Tokyo). pp 329-331 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A compound superconductor of the wire-type has not been in practical use for a magnet because of its poor bending characteristics. We have developed flexible multifilamentary V_3Ga wire and made several magnets from it. Their coil performances were very stable and reproducible. The magnet withstood high-speed excitation up to 25 kG/s. (auth)

5522 LARGE-SCALE REFRIGERATORS WITH TURBINES. Carbonell, E. (Centre d'Etudes Cryogeniques, Sassenage, France). pp 353-356 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Refrigerators intended for cooling cryoelectric machinery must be determined according to the due date and the industrial working requirements. The turboexpanders' characteristics lead us to recommend the Claude cycle with a two turboexpander series arrangement. This closed cycle will be associated with a hypercritical helium cold loop fitted with a cold compressor derived from turboexpander technology. It is concluded that the state of the art of refrigerators would be improved if substantial progress could be made in helium compression. (auth)

5523 REFRIGERATION TECHNOLOGY IN JAPAN. Oshima, K.; Ishizaki, Y. (Tokyo Univ.). pp 357-360 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The present state of refrigeration technology in Japan is reviewed. The chief requirement for the development of industrial refrigeration technology is the accumulation of basic engineering data, and the development of components. The work conducted by the authors' group at the University of Tokyo, on Stirling cycle machines, is one example of the activity in this field. (auth)

5524 EXPERIMENTS ON A MODIFIED KIRK CYCLE REFRIGERATOR. Oshima, I.; Kawaguchi, E.; Yanai, M.; Matsubara, Y. (Osaka Oxygen Industries Ltd.). pp 361-366 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A small Kirk cycle refrigerator with an electrodynamic linear driving method has been built and tested. It drives in perfect oil-free condition by eliminating all crank mechanisms. The compression device consists of a moving coil directly connected to a compression piston, and a permanent magnet. The compression piston reciprocates 3600 times per minute with 100 V, 60 Hz alternating current, which is commercially available. The expansion piston moves pneumatically because of the pressure difference between the two sides of the piston. The performance of the tested refrigerator was 5.3 W of refrigeration output at 78°K when consuming 292 W of input power. (auth)

5525 VALVELESS PISTON EXPANSION ENGINE WITH 6-PHASE GAS DISTRIBUTION CYCLE. Dobrov, V. M.; Orlov, A. V. (Inst. of Theoretical and Experimental Physics, Moscow). pp 367-368 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A valveless piston expansion engine with six-phase gas distribution cycle, developed for work with a helium liquefier is described. It uses a working cycle analogous to that of a valve expansion engine, so that it has an efficiency which approaches that of the latter machine. (auth)

5526 LOW-TEMPERATURE CENTRIFUGAL HELIUM COMPRESSOR. Kawada, M. (Electrotechnical Lab., Tokyo); Togo, S.; Akiyama, Y.; Wada, R. pp 369-372 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A centrifugal helium compressor with gas bearings, which can be operated at the temperature of liquid nitrogen, was investigated. This compressor has the advantages that the compression ratio should be higher than the room temperature operation and that the contamination of helium could be eliminated. The outer diameter of the rotor is 112 mm. The experimental result for helium gas at low temperature shows that the flow rate was 47 g/s and the compression ratio was 1.2 when the inlet pressure was 1 ata and the rotational speed was 550 rev/s. The investigation is now focused on obtaining a compression ratio of 1.5. (auth)

5527 CENTRIFUGAL COMPRESSOR WITH GAS-LUBRICATED BEARINGS. Sixsmith, H. (Oxford Univ.). pp 373-375 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The development of a small centrifugal compressor with gas-lubricated bearings is described. The diameter of the impeller is 63 mm and the design speed is 140,000 rev/min. The impeller is driven by a three-phase induction motor. The pressure ratio with helium gas is 1.26. At a mass flow rate of 40 g/s the electrical power input is approximately 11.0 kW. Eleven compressor units connected in series should give an overall pressure ratio of 12.6. (auth)

5528 MINIATURE ROTARY COMPRESSOR FOR APPLICATION WITH SMALL CRYOGENIC REFRIGERATORS. Horn, S. B.; Acord, T. T.; Walters, B. T. (Army Electronics Command, Fort Belvoir, VA). pp 376-379 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A miniature rotary compressor has been designed and fabricated to be used as a component of a small cryogenic cooler system. The modified geometry of the rotary compressor is used to produce periodic pressure waves. The pressure wave is generated due to a volumetric change in one chamber of a two-lobed peritrochoid housing divided into three chambers by a rotor while the other two chambers are shorted to the crankcase. The use of this compressor in Stirling-type refrigerators will be analysed. (auth)

5529 COMBINED HELIUM REFRIGERATOR AND LIQUEFIER WITH GAS BEARING TURBINES. Giger, U.; Quack, H.; Senn, A. (Sulzer Bros. Ltd., Winterthur, Switzerland). pp 380-383 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

In establishments with several users of refrigeration, such as separate superconducting magnet systems, the most economical choice is to have them all connected to a central refrigeration unit. At the Swiss Institute for Nuclear Research a plant has been put into operation which delivers refrigeration to two magnet systems. Cooling capacity which is not needed for the magnets is used to liquefy helium into a storage vessel. One of the most important properties of the plant is the possibility to cool down one magnet without changing the cooling conditions of the other. The plant, which is equipped with self-energizing gas bearing turbines is described. (auth)

5530 DESIGN OF A SMALL CENTRIFUGAL PUMP FOR SUBCOOLED AND BOILING LIQUIDS (77 < T < 300 K). Engel, J. (Technical Univ., Berlin); Walter, H. pp 384-386 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The design details of a small pump for subcooled and boiling cryogenic liquids at temperatures above 77°K are discussed. The bearing problems due to the necessary narrow clearances, the high speed, and the frictional heat are successfully overcome. It is shown that conventional design features can be applied even to such small-scale pumps. (auth)

5531 APPLICATION OF A 20 K REFRIGERATOR TO REDUCING BOIL-OFF RATE OF A LIQUID HELIUM DEWAR. Longsworth, R. C. (Air Products and Chemicals Inc., Allentown, PA). pp 390-394 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

As applications for continuously operating superconducting devices increase, the need for closed-cycle cooling of the dewars increases. Many of these devices are small magnets with a very small heat load at 4.2°K. This paper describes the application of a two-stage 20°K closed-cycle Displex refrigerator to intercept heat leak at 77°K and 20°K. This has been demonstrated to reduce the helium boiloff rate in a typical magnet dewar from 0.15 l/h to less than 0.006 l/h. A thermal design analysis is presented which serves to identify the important factors in dewar design and help in the selection of the best refrigerator. (auth)

5532 ALUMINUM-STABILIZED MULTIPLEX SUPERCONDUCTOR AND MAGNET. Nomura, H. (Electrotechnical Lab., Tokyo); Tokoriki, I.; Terao, K.; Tago, M. pp 399-402 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The newly developed high-purity aluminium-clad multiplex superconductor has a higher stability in both the dc case and ac case by eliminating coupling current by insulation and transposition of each wire. It can be widely applied to such magnets as those which are used for transportation such as trains, airplanes and ships. (auth)

5533 REMOVABLE CURRENT LEADS FOR SUPERCONDUCTING MAGNETS. Satow, T. (Mitsubishi Electric Corp.,

Amagasaki, Japan); Fukuhara, K.; Yamada, T.; Iwamoto, M.; Shinobu, M. pp 403-405 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Two kinds of 1000 A removable current lead were constructed and tested for the purpose of reducing the heat losses in superconducting magnets in a high-speed train. As preliminary considerations, the types of gas-cooled removable current lead were discussed, and the reliability of the contacts was investigated. Contacts with resistances below 1 $\mu\Omega$ at cryogenic temperatures were made. (auth)

5534 ANALYSIS OF THE TRANSITION PROCESS OF THERMALLY AND MAGNETICALLY CONTROLLED POWER SWITCHES. Matsumoto, Y. (Osaka Univ.); Kitamura, S.; Murakami, Y.; Nishimura, M.; Tanaka, Y. pp 406-408 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

This paper describes experimental and simulation studies on the effects of external heating and magnetic field on the transition process, for development of thermally and magnetically controlled superconductive power switches. The simulation results by our model agree with the experimental ones, which enables one to obtain several quantities such as the distribution of temperature or resistance, and to infer the effects of external magnetic field. (auth)

5535 DEVELOPMENT OF VACUUM-TYPE PERSISTENT CURRENT SWITCHES. Kuwabara, K.; Sugawara, H. (Hitachi Research Lab., Ibaraki, Japan). pp 409-412 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

New types of mechanical persistent current switches are introduced, whose contacts are set in vacuum. The overall resistance of the switch with oxygen-free copper contacts was 0.13 $\mu\Omega$ at a current of 100 A to 1000 A under contact force of 30 kg. The switch with superconducting alloy contacts showed an overall resistance of 0.025 $\mu\Omega$ and was able to pass a current of 500 A without transition from superconducting to normal. These switches can also be used as emergency switches. In experiments, switches discharged 200 A of the persistent current of a 4.5 mH magnet down to 4A within only 20 ms. (auth)

5536 SOME PROBLEMS OF FORCE-COOLED SUPERCONDUCTING MAGNET SYSTEMS. Keilin, V. E.; Klimenko, E. Yu.; Kovalev, I. A.; Novikov, S. I.; Saprikin, Yu. E.; Samoylov, B. N.; Chernoplekov, N. A. (Inst. of Atomic Energy, Moscow). pp 413-416 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Two force-cooled superconducting magnet systems (a model coil and the installation CMS-0.25) and the results of their testing are described. The main sources of thermal disturbances in the systems are analyzed, as well as the methods of their detection and elimination. (auth)

5537 FORCE-COOLED SUPERCONDUCTING MAGNET WITH DOUGHNUT-SHAPED CRYOSTAT. Kimura, H.; Ogata, H.; Sato, S.; Tomeoku, H. (Hitachi Ltd., Tokyo). pp 417-419 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A superconducting magnet which is force-cooled by liquid helium flow through its cryostat has been built and tested. A superconducting wire for the magnet is composed of 271 fine-filaments of Nb-Ti-Zr ternary alloy and has a copper-to-superconductor ratio of 7.2. The coil, which has a mean diameter of 30 cm, is sealed off inside a doughnut-shaped annular cryostat. The coil performance showed almost no degradation for a force-cooled experiment. The maximum magnetomotive force and the overall current density of the coil attained 538 kAT and 1.46×10^4 A/cm^2, respectively. The relation between the coolant flow velocity in the cryostat and the coil quenching current is discussed. (auth)

5538 CONTINUOUS SUPERCONDUCTING LEVEL INDICATOR FOR SUPERFLUID HELIUM. Ishizuka, M.; Yasukochi, K.; Yasohama, K.; Kobayashi, H. (Nihon Univ., Tokyo). pp 451-453 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A continuous level indicator using superconducting wire is exhibited to be feasible in superfluid state of liquid helium. By an appropriate selection of diameter of wire and transport current, the normal region propagates only in the part of the wire above liquid level owing to the difference of heat transfer between the gaseous state and the superfluid state. The liquid level is detected continuously as a terminal voltage of the wire. (auth)

5539 COLD AND ULTRA-COLD NEUTRONS: A TEST FACILITY FOR CRYOGENIC ENGINEERING. Ageron, P. (ILL, Grenoble, France); Astruc, J. M.; Lacaze, A.; Verdier, J. pp 458-460 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The industrial applications of cryogenics are often held back by doubts about reliability. The Grenoble cold neutron source, with which an operating rate of 99.4% has been achieved, and which hence augurs well for the future of industrial plants working near 4°K is described. (auth)

5540 NEW, SIMPLE VARIABLE-TEMPERATURE CRYOSTAT. Gmelin, E.; von Alpen, U. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart). pp 461-464 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A new, simple variable temperature cryostat, based on a steady-state vapor bubble is described. Simplicity, easy handling and great temperature stability characterize the system. (auth)

5541 DESIGN AND CONSTRUCTION OF AN APPARATUS FOR TESTING MATERIALS AT CRYOGENIC TEMPERATURE. Horiuchi, T.; Shimada, M.; Fukutsuka, T.; Tokuda, S. (Kobe Steel Ltd., Japan). pp 465-468 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A sophisticated mechanism for repetitive mechanical testing of materials at temperatures down to 4.2°K is described. The apparatus permits a number of specimens prelocated on a turret disc to be cooled simultaneously in the cryostat, and mechanical tests to be performed in sequence without the need to disclose the cryostat to atmosphere. Such a multiple-specimen device gives the advantage of improving productivity by about a factor of eleven, and of reducing the consumption of the cooling liquid to about one-tenth of the conventional value. Moreover, the restraints on the choice of specimen design are lessened with the adoption of a specially designed specimen holder. (auth)

5542 EVAPORATION CRYOSTAT AND SUPERCONDUCTING QUENCHED BISMUTH FILMS. Takano, Y.; Yotsuya, T.; Tanaka, Y.; Shigi, T. (Osaka City Univ.). pp 469-472 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A He^4 evaporation cryostat has been constructed for studies of a superconducting film quenched on a substrate at liquid helium temperature. Heat radiation and contaminating residual gases are carefully diminished. Preliminary experiments also reported are on diamagnetic susceptibility induced by fluctuating Cooper pairs in quenched bismuth films. (auth)

5543 STABILITY OF COILS WOUND WITH FINE MULTIFILAMENTARY SUPERCONDUCTING WIRES. Kuroda, K.; Kudo, M.; Kimura, H.; Hara, N. (Hitachi Ltd., Tokyo). pp 500-503 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Stability of superconducting coils was studied from thermal and mechanical viewpoints. Fifty-six coils wound with various

fine multifilamentary superconducting wires were investigated with respect to the training effect, current degradation, and minimum propagating current. In particular, the first quenching current in the initial excitation was compared with the minimum propagating current and analyzed in reference to a winding tension and magnetic pressure at the quenching. From the analysis, it was shown that the magnetic expansive pressure at quenching balanced with the compressive pressure due to the winding tension and the stability of those coils depended strongly on a mechanical instability, i.e., "wire movement" in the winding rather than thermal instability. (auth)

5544 SUPERCONDUCTING HIGH FREQUENCY HIGH POWER RESONATORS. Hobbis, C.; Vardiman, R.; Weinman, L. (Naval Research Lab., Washington, DC). pp 539-541 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A niobium superconducting quarter-wave helical resonator has been designed and built. The resonator has been electron-beam welded and electropolished to produce a smooth flaw-free surface. This has been followed by anodization to produce a 1000 Å layer of Nb_2O_5. At the resonant frequency of approximately 15 MHz the unloaded Q was $\simeq 4.6 \times 10^6$ with minimal dielectric support. With the resonator open to the helium bath to provide cooling, and rigidly supported by a teflon cylinder, 350 V of power was transferred at a doubly loaded Q of 3500. The extrapolation of the results of a Q_{DL} of 1000 meet the power handling criteria of one kilowatt for the intended application. (auth)

5545 LONG-TERM EXPERIENCE WITH THE LIQUEFYING STAGE AND A 4.4 K COOLING CYCLE OF A 300 W REFRIGERATOR. Katheder, H.; Lehmann, W.; Spath, F. (Kernforschungszentrum, Karlsruhe, Ger.). pp 546-549 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

For research work in the field of superconductivity a 300 W, 1.8 K refrigerator built by Linde AG, Germany was put into operation in 1971. This refrigerator is connected to several experimental set-ups. As the refrigerator is designed for multipurpose use it is possible to use it also as a liquefier and as a refrigerator at 4.4 K and higher. Experiences encountered during operation of the refrigerator and the 4.4 K magnet refrigeration cycle are described. Furthermore, an outlook on future installations is given. (auth)

5546 LOW BOIL-OFF CONTAINMENT OF ROTATING CRYOGENIC LIQUIDS IN 100 mm AND 450 mm DIAMETER ROTORS AT SPEEDS UP TO 330 RAD/S. Scurlock, R. G.; Thornton, G. K. (Univ. of Southampton, Eng.). pp 566-569 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The development of helium refrigeration techniques for superconducting turbo-generators requires laboratory-size rotating cryostats with low boil-off containment of liquid helium. Preliminary work has shown that high boil-off rates during rotation can be prevented by the use of baffles in the neck of a rotating dewar. This paper reports measurements of neck temperature profiles using thermocouples and liquid nitrogen in the high-speed rotating frame from which the neck flow patterns with and without baffles may be deduced. These profiles indicate that the non-rotating core can have temperatures 50 to 100°K higher than the cold annular rotating stream attached to the neck wall, when no baffles are used in a 50 mm diameter neck. The flow between the baffles is complex, but temperature differences within the vapour space enclosed by 2 baffles is less than 5°K. Preliminary runs with a 450 mm diameter rotor incorporating a 50 mm diameter neck and baffles indicate satisfactory behavior with liquid helium under rotation. (auth)

5547 CRYOGENIC COOLERS FOR SPACE SYSTEMS. Vance, R. W. (Aerospace Corp., Los Angeles). pp 578-582 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The state-of-the art of small refrigerators that may be capable of performing in space with a high degree of reliability is reviewed. Candidate cooling systems vary from open-cycle concepts for missions of short duration (up to one year) to mechanical concepts for missions that are projected to be operational for several years. Performance predictions for both types of concepts are described. Emphasis is placed on three mechanical systems: the high-speed turbine concept, the heat-driven Vuilleumier (VM) concept, and the rotary-reciprocating concept. The predictions and the factors that have an impact on the acceptance of those predictions are discussed. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 5568, 6692, 6719, 6785–6787, and 6862.

5548 (KAPL-M-7399) DERIVATION OF A LOW FLOW SLIP MODEL. Maneri, C. C. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). 23 Oct 1967. 17p. Dep. NTIS $4.50.

An expression for slip ratio is derived by coupling the Zuber-Findlay void model with the Wallis flooding criterion. The behavior of the slip ratio for various limiting cases is investigated and it is shown that it approaches realistic limits. (auth)

5549 (ORNL-TM-4759) MODEL TO CALCULATE MASS FLOW RATE AND OTHER QUANTITIES OF TWO-PHASE FLOW IN A PIPE WITH A DENSITOMETER, A DRAG DISK, AND A TURBINE METER. Aya, I. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 57p. Dep. NTIS $5.45.

The proposed model was developed at ORNL to calculate mass flow rate and other quantities of two-phase flow in a pipe when the flow is dispersed with slip between the phases. The calculational model is based on assumptions concerning the characteristics of a turbine meter and a drag disk. The model should be validated with experimental data before being used in blowdown analysis. In order to compare dispersed flow and homogeneous flow, the ratio of readings from each flow regime for each device discussed is calculated for a given mass flow rate and steam quality. The sensitivity analysis shows that the calculated flow rate of a steam-water mixture (based on the measurements of a drag disk and a gamma densitometer in which the flow is assumed to be homogeneous even if there is some slip between phases) is very close to the real flow rate in the case of dispersed flow at a low quality. However, it is shown that the measurement with a turbine meter and a densitometer overestimates the flow rate at low and middle qualities and underestimates it at high quality. The model is also compared with the methods of Rouhani and Popper used to measure the void fraction with one and two turbine meters respectively. The comparison with Rouhani's experimental data of a turbine meter in vertical upflow in a straight tube shows that there are no significant differences among the models for the estimation of void fraction. These four models yield average errors between -1.4 and 3.8 percent. However, there are large differences in the calculation of mass flow rate. At a steam quality below 5 percent and a slip ratio below 4.5, Rouhani's method predicts flow rate the best. The homogeneous model and Popper's model overestimate less than 11 percent, and the proposed model underestimates by 5 to 11 percent. As the steam quality increases at a constant slip ratio, all models are prone to overestimate. At 20 percent quality the overestimates reach 8 percent in the proposed model, 15 percent in Rouhani's model, 38 percent in homogeneous model, and 75 percent in Popper's model. (auth)

5550 (TRG-Report-2684(R)) THREAT: A 3-D HEAT TRANSFER PROGRAM. Collier, W. D. (UKAEA Reactor Group, Risley). Jun 1975. 30p. Dep. NTIS (US Sales Only) $5.00. UK pounds 1.00.

Prismatic finite elements are used to build up three dimensional models over which the heat conduction equation is solved. A wide range of boundary conditions makes the program applicable in a variety of circumstances. (auth)

5551 (UCRL-51877) VAPOR-DROPLET FLOW EQUATIONS. Crowe, C. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Aug 1975. Contract W-7405-Eng-48. 31p. Dep. NTIS $4.00.

General features of a vapor-droplet flow are discussed and the equations expressing the conservation of mass, momentum, and energy for the vapor, liquid, and mixture using the control volume approach are derived. The phenomenological laws describing the exchange of mass, momentum, and energy between phases are also reviewed. The results have application to development of water-dominated geothermal resources. (auth)

5552 EXPERIMENTAL STUDY OF HEAT TRANSFER TO LIQUID METALS FLOWING IN-LINE THROUGH TUBE BUNDLES. Graber, H.; Rieger, M. Progr. Heat Mass Transfer; 7: 151-166 (1973).

Nusselt numbers for the Na–K alloy (44/56) were obtained in the Peclet range Pe = 110...4300 for the three pitch-to-dia. ratios p/d = 1.25, 1.60, and 1.95 with two test sections each, one being built as a heater with electrically heated tubes and the other as a heat exchanger in a "figure-eight" loop. Thirty-one tubes of d = 12 mm OD were arranged in an equilateral triangular lattice. Both the wall temperature of the tubes and the fluid temp. in the centers of the subchannels were measured by means of ~80 thermocouples/test section. The experimental results for constant heat flux satisfy the relation $Nu = a + b\ Pe^c$, where the constants $a = 0.25 + 6.20\ p/d$, $b = -0.007 + 0.032\ p/d$, and $c = 0.800 - 0.024\ p/d$. (Metals Abstr.)

5553 TRANSFINITE INTERPOLATION OF STEAM TABLES. Hall, C. A. (Univ. of Pittsburgh, Pittsburgh); Mutafelija, B.A. J. Comput. Phys.; 18: No. 1, 79-91(May 1975).

In engineering practice, real time stimulation, reactor accident analysis, etc., it is often necessary to obtain very accurate but simple relationships between steam and water properties with minimum computer storage requirements. The notion of "transfinite element," developed by Gordon and Hall, is used as a basis for an interpolation scheme which gives simple functional relationships between steam and water properties, such as enthalpy, considered as a function of pressure and temperature. (auth)

5554 EVALUATIONS OF CORRELATIONS FOR TWO-PHASE FLOWMETERS THREE CURRENT–ONE NEW. Smith, R. V.; Leang, J. T. (Wichita State Univ., Wichita, KS). J. Eng. Power; 97: No. 4, 589-593(Oct 1975).

The two-phase flowmeter correlations of James, Marriott, and Murdock are evaluated using data for orifices and for venturi and nozzles previously reported. Further, a new correlation is proposed for the case where the phases may be treated as separated and this correlation is evaluated using the same data. (auth)

5555 EFFECT OF A STABILIZING TEMPERATURE GRADIENT ON HEAT TRANSFER FROM A MOLTEN FUEL LAYER WITH VOLUMETRIC HEATING. Suo-Anttila, A. J.; Catton, I. (Univ. of California, Los Angeles). J. Heat Transfer; 97: No. 4, 544-548(Nov 1975).

The Landau method is used to determine the heat transfer to the upper and lower surfaces of a volumetrically heated layer of molten fuel for various fixed values of the upper and lower surface temperatures. To use the Landau method, the Stuart shape assumption is imposed and solutions to the linearized stability problem are used. The results are generalized in terms of two Nusselt numbers (upper and lower surface heat transfer) which are presented as a function of the Rayleigh number based on the internal heat generation rate for various values of an external Rayleigh number based on the surface to surface temperature difference. Results are also presented for a molten UO_2 layer for various typical values of decay heat. Comparison is made with experiment, where possible, and found to be good. 12 references. (auth)

Materials Testing

Refer also to abstracts 5981, 6083, and 6872.

5556 (CONF-750947-, pp 51-81) BEAM-INDUCED TEMPERATURE CHANGES IN HVEM IRRADIATIONS. Garner, F. A.; Thomas, L. E.; Gelles, D. S. Sep 1975.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

In experimental methods for charged-particle irradiations. (Atomics International Div., Canoga Park, Calif. (USA)).

The peak value of the temperature distribution induced by energy loss of 1.0 MeV electrons in traversing a typical HVEM irradiation specimen can be very substantial. The origin and various features of this distribution were analyzed for a variety of specimen geometries. The major parametric dependencies are shown to be relatively independent of specimen geometry, however, and allow the definition of a scaling relationship that can be employed to predict temperature rises in materials that cannot be measured directly. The use of this scaling relationship requires that the experimenter minimize perturbations of the heat flow due to proximity of the central hole in the specimen. An experimental method of determining directly the magnitude and distribution of beam-induced temperature profiles was developed which utilizes the order-disorder transformation in Fe_3Al and Cu_3Au. Scaling of experimentally determined temperature changes leads to more realistic estimates of the total temperature rise than are currently available in various literature tabulations. The factors which determine the optimum selection of irradiation parameters for a given experiment are also discussed. (auth)

5557 QUALITY CONTROL AND NON-DESTRUCTIVE TESTING IN WELDING. Volume 2. International Conference Held at London, 19–21 November 1974. Abington, England; Welding Institute (1975). 175-204p. (CONF-741171–P2).

From international conference on quality control and non-destructive testing in welding; London, UK (19 Nov 1974).

An account of the discussions pertaining to the papers presented are given. (TFD)

5558 QUALITY CONTROL AND NON-DESTRUCTIVE TESTING IN WELDING. Volume 1. International Conference Held at London, 19–21 November 1974. Abington, England; Welding Institute (1975). 176p. (CONF-741171–P1).

From international conference on quality control and non-destructive testing in welding; London, UK (19 Nov 1974).

Separate abstracts were prepared for 3 of the 22 papers presented at the conference. The remaining 19 papers are not in scope for NSA. (TFD)

For abstracts of individual papers see: 5559–5561.

5559 INVESTIGATION OF THE IMPROVEMENT OF SPEED AND RELIABILITY IN THE INSPECTION OF FIELD-WELDED PIPELINES. Nakayama, M.; Kato, Y.; Isono, E. (Nippon Steel Corp., Sagamihara City, Japan). pp 62-66 of Quality Control and Non-destructive Testing in Welding. Abington, England; Welding Institute (1975).

From international conference on quality control and non-destructive testing in welding; London, UK (19 Nov 1974).

The newly developed x-ray crawler and the self-driving automatic ultrasonic flaw detector for testing welded pipelines are introduced. The x-ray equipment, which can be remotely controlled by a radioactive isotope and by electromagnetic signals, has improved the detectability of defects and can shorten the testing time to one-quarter of that of the conventional method. The ultrasonic equipment, which employs a guide rail, rotating scanning of probes, and a polarograph recorder, has shortened the testing time with good reproducibility. The ultrasonic equipment can accommodate up to four probes and in 2 min can test girth-welded joints in pipelines having a dia of 600mm. The detectability characteristics of defects in welded pipelines is different between x-ray and ultrasonic testing. Therefore, the wall thickness and diameter of the pipes and the kind of defects in the welded joints should be carefully studied before practical application. (auth)

5560 B SCAN PRESENTATION OF ULTRASONIC RESULTS AS APPLIED TO THICK-WALLED PRESSURE VESSELS. Watkins, B.; Jackson, H. (Risley Engineering and Materials Lab., Eng.). pp 79-91 of Quality Control and Non-destructive Testing in Welding. Abington, England; Welding Institute (1975).

From international conference on quality control and non-destructive testing in welding; London, UK (19 Nov 1974).

The B scan method of presentation shows a pictorial record of ultrasonic test results as a cross section of the component, the most relevant view from the fracture mechanics standpoint. (TFD)

5561 NON-DESTRUCTIVE TESTING TUBE-TO-TUBEPLATE WELDS. Jackson, H.; Tickle, H.; Walker, D. C. B. pp 159-166 of Quality Control and Non-destructive Testing in Welding. Abington, England; Welding Institute (1975).

From international conference on quality control and non-destructive testing in welding; London, UK (19 Nov 1974).

In recent years tube-to-tubeplate welding technology has made significant progress towards the manufacture of automated welded joints. Unfortunately conventional techniques do not permit most of the welds to be inspected to a sufficiently high standard to ensure integrity. The various techniques developed at Risley Engineering Materials Laboratory (REML) for tube-to-tubeplate inspection of the sodium/water heat exchangers (HEs) for sodium-cooled fast reactors are described. These techniques have since been modified and applied to HEs in both the chemical and nuclear industries. The methods described include sophisticated γ and microfocus x-ray techniques, magnetography, and complex visual systems. All the techniques used are capable of producing permanent records. The techniques described were used during the manufacture of the HE but in general are not suitable for periodic in-service inspection. The development of ultrasonic techniques for this application is described. Evidence for the high standards of inspection which can be applied to different types of tube-to-tubeplate joints is presented. (auth)

5562 MODERN DEVICES FOR MACROSTRUCTURE TESTING WITH ^{192}Ir. Isotopenpraxis; 11: No. 7, 260-262(Jul 1975). (In German).

The requirements placed on devices for the nondestructive γ radiography of materials are briefly summarized. The characteristics of three radiographic instruments using ^{192}Ir as the γ source are tabulated and compared with each other. (auth)

Nuclear Explosions

5563 (AWRE-O-21/74) PEACEFUL USES OF NUCLEAR EXPLOSIVES. Review Paper No. 5. Semi-empirical Prediction of Configurations Produced by Contained Nuclear Explosions. Gatfield, L. P. K. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Sep 1975. 40p. Dep. NTIS (US Sales Only) $5.00. UK pounds 1.00.

The phenomenology of contained nuclear explosions is discussed, and simple semi-empirical formulas are presented that can be used to predict to an accuracy within 25% the post-shot dimensions of the cavity formed in a given geologic medium. This information is of use to experts considering peaceful uses of nuclear explosions, e.g., in the mining, and petroleum industries. (LCL)

5564 (LA-6090-MS) PACER PROCESSING: CAVITY INVENTORY RELATIONSHIPS. Dietz, R. J.; Gritzo, L. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 16p. Dep. NTIS $4.00.

The Pacer cavity and its associated primary power loop comprise a recirculating system in which materials are introduced by a series of thermonuclear explosions while debris is continuously removed by radioactive decay, sorption phenomena, and deliberate processing. Safe, reliable, and economical realization of the Pacer concept depends on the removal and control of both noxious and valuable by-products of the fusion reaction. Mathematical relationships are developed that describe the quantities of materials that are introduced into the Pacer cavity by a series of discrete events and are removed continuously by processing and decay. An iterative computer program based on these relationships is developed that allows both the total cavity inventory and the amounts of important individual species to be determined at any time during the lifetime of the cavity in order to establish the effects of the thermonuclear event, the cavity, the flow, and various processing parameters on Pacer design requirements. (auth)

5565 (ORNL--4919) EFFECTS OF NUCLEAR ELECTROMAGNETIC PULSE (EMP) ON SYNCHRONOUS STABILITY OF THE ELECTRIC POWER SYSTEM. Manweiler, R. W. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 91p. Dep. NTIS $5.45.

The effects of a nuclear electromagnetic pulse (EMP) on the synchronous stability of the electric power transmission and distribution systems are evaluated. The various modes of coupling of EMP to the power system are briefly discussed, with particular emphasis on those perturbations affecting the synchronous stability of the transmission system. A brief review of the fundamental concepts of the stability problem is given, with a discussion of the general characteristics of transient analysis. A model is developed to represent single sets as well as repetitive sets of multiple faults on the distribution systems, as might be produced by EMP. The results of many numerical stability calculations are presented to illustrate the transmission system's response from different types of perturbations. The important parameters of both multiple and repetitive faults are studied, including the dependence of the response on the size of the perturbed area, the fault density, and the effective impedance between the fault location and the transmission system. Both major load reduction and the effect of the opening of tie lines at the time of perturbation are also studied. We conclude that there is a high probability that EMP can induce perturbations on the distribution networks causing a large portion of the transmission network in the perturbed area to lose synchronism. The result would be an immediate and massive power failure. (auth)

5566 (PNE-RB--72) PROJECT RIO BLANCO DEFINITION PLAN. Additional Formation Evaluation and Production Testing (Energy Research and Development Administration, Las Vegas, Nev. (USA). Nevada Operations Office). Sep 1975. 53p. (NVO--165). Dep. NTIS $5.50.

Since the multiple Rio Blanco detonation three reentry wells have been drilled for test purposes: RB-E-01 (Emplacement Well); RB-AR-2 (Alternate Reentry Well); and RB-U-4 (Formation Evaluation Well). Additional testing in all these wells is now required to resolve some remaining technical questions. A plan describing the procedures, methods, responsibilities, and scheduling of the field operations is presented. (TFD)

5567 (UCRL-13662) TRANSIENT COMPRESSIBLE FLOWS IN POROUS MEDIA. Morrison, F. A. Jr. (Illinois Univ., Urbana (USA)). Sep 1975. 88p. Dep. NTIS $6.00.

For The Regents of the Univ. of California.

Transient compressible flow in porous media was investigated analytically. The major portion of the investigation was directed toward improving the understanding of dispersion in these flows and developing rapid accurate numerical techniques for predicting the extent of dispersion. The results are of interest in the containment of underground nuclear experiments. The transient one-dimensional transport of a trace component in a gas flow is analyzed. A conservation equation accounting for the effects of convective transport, dispersive transport, and decay, is developed. This relation, as well as a relation governing the fluid flow, is used to predict trace component concentration as a function of position and time. A detailed analysis of transport associated with the isothermal flow of an ideal gas is done. Because the governing equations are nonlinear, numerical calculations are performed. The ideal gas flow is calculated using a highly stable implicit iterative procedure with an Eulerian mesh. In order to avoid problems of anomalous dispersion associated with finite difference calculation, trace component convection and dispersion are calculated using a Lagrangian mesh. Details of the Eulerian-Lagrangian numerical technique are presented. Computer codes have been developed and implemented on the Lawrence Livermore Laboratory computer system. (TFD)

5568 (UCRL--51901) CALCULATIONAL MODEL FOR CONDENSATION OF WATER VAPOR DURING AN UNDERGROUND NUCLEAR DETONATION. Knox, R. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1975. Contract W-7405-Eng-48. 34p. Dep. NTIS $4.00.

An empirally derived mathematical model was developed to calculate the pressure and temperature history during condensation of water vapor in an underground-nuclear-explosion cavity. The condensation process is non-isothermal. Use has been made of the Clapeyron-Clausius equation as a basis for development of the model. Analytic fits to the vapor pressure and the latent heat of vaporization for saturated-water vapor, together with an estimated value for the heat-transfer coefficient, have been used to describe the phenomena. The calculated pressure-history during condensation has been determined to be exponential, with a time constant somewhat less than that observed during the cooling of the superheated steam from the explosion. The behavior of the calculated condensation-pressure compares well with the observed-pressure record (until just prior to cavity collapse) for a particular nuclear-detonation event for which data is available. (auth)

5569 ELECTROMAGNETIC PULSE (EMP) PROPAGATION THROUGH AN ABSORPTIVE AND DISPERSIVE MEDIUM. Arnush, D. (TRW Systems Group, Redondo Beach, CA). Contract F04(701)70-C-0165. IEEE (Inst. Electr. Electron. Eng.) Trans. Antennas Propag.; AP-23: No. 5, 623-626(Sep 1975).

A numerical technique for solving the high frequency approximation electromagnetic pulse (EMP) equations is presented. The Lorentz model of the secondary electron current is used, thereby achieving a result valid for a burst above the ground and observer at any altitude. Comparisons of the results of this technique and those techniques which assume an ohmic secondary electron current are made, and it is found that they are identical for observations below 40 km but differ markedly above 80 km. (auth)

Protective Structures and Equipment

5570 (CONF-751029-2) DESIGN REQUIREMENTS AND PERFORMANCE REQUIREMENTS FOR REACTOR FUEL RECYCLE MANIPULATOR SYSTEMS. Grundmann, J. G. (Oak Ridge National Lab., Tenn. (USA)). 1975. 14p. Dep. NTIS $4.50.

From national bureau of standards workshop; Annapolis, Maryland, USA (23 Oct 1975).

The development of a new generation of remote handling devices for remote production work in support of reactor fuel recycle systems is discussed. These devices require greater mobility, speed and visual capability than remote handling systems used in research activities. An upgraded manipulator system proposed for a High-Temperature Gas-Cooled Reactor fuel refabrication facility is described. Design and performance criteria for the manipulators, cranes, and TV cameras in the proposed system are enumerated. (LCL)

5571 (INIS-mf-1409) ELECTROSTATIC AIR CLEANING BY RADIOACTIVE IONIZATION. Dua, S. K.; Kotrappa, P.; Bhanti, D. P.; Sundararajan, A. R. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. (CONF-730495-2). INIS.

From 1st annual conference of Indian Association for radiation protection; Bombay, India (12 Apr 1973).

Industrial electrostatic air cleaning is based on the principle of charging the aerosol by corona discharge and subsequent removal of the charged aerosols by collecting electrodes. In the present study, charging of the aerosol is achieved by radioactive ionization in a parallel plate chamber with a 10 Ci ^{192}Ir source. The chamber plates are maintained at any desired voltage. Methylene blue aerosols were used as test aerosols. Removal efficiency of the methylene blue aerosol was measured by vary-

ing the different parameters, viz. electric field, irradiation field and the flow rates. With an electric field of about 5000 V/cm, the removal efficiency varied from 80% to 90% when the flow velocities were varied from 1250 cm/min to 625 cm/min. The parameters obtained in this study can be made use of to design an electrostatic air cleaning system using a radioactive isotope. (auth)

Safety Engineering

5572 (CONF-750607-32) NEW METHOD FOR ABBREVIATING THE FAULT TREE GRAPHICAL REPRESENTATION. Stewart, M. E.; Fussell, J. B.; Crump, R. J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Dec 1974. 4p. Dep. NTIS $4.50.

From American nuclear society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Fault tree analysis is being widely used for reliability and safety analysis of systems encountered in the nuclear industry and elsewhere. A disadvantage of the fault tree method is the voluminous fault tree graphical representation that conventionally results from analysis of a complex system. Previous methods for shortening the fault tree graphical representation include (1) transfers within the fault tree, and (2) the use of the SAMPLE (K out of N logic) gate, the MATRIX gate, and the SUMMATION gate. The purpose of this presentation is to introduce TABULATION gates as a method to abbreviate the fault tree graphical representation. These new gates reduce the cost of analysis and generally increase the system behavior visibility that is inherent in the fault tree technique. (auth)

Vacuum Engineering

5573 CONDENSATIONAL PUMPING: THE CLOSEST APPROXIMATION TO AN IDEAL METHOD OF OBTAINING ULTRAHIGH VACUUM. Grishin, S. F. (Physical-Technical Inst., Kharkov). pp 271-275 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A close approach to a hypothetical ideal method of obtaining vacuum would be a method which satisfied the following conditions: the possibility of obtaining any degree of rarefaction; pumping maximum specific speeds at pumping-out great volumes of gas; providing extremely pure vacuum conditions (absence of contamination produced by a pumping device); the possibility of building a pump of any configuration; maximum simplicity of equipment combined with convenience and simplicity of maintenance; and effectiveness. To elucidate the prospects of the condensational method in producing very low pressures, measurements of nitrogen saturated vapor pressure at hydrogen temperatures, and hydrogen at helium temperatures down to saturated vapor pressures of $\sim 10^{-10}$ torr were performed. These measurements gave satisfactory agreement with the data derived by extrapolation from a higher temperature range in Honing and Hook's work, and thus they confirmed the possibility of using extrapolation data on vapor pressures within a wide temperature range. (RCK)

ENVIRONMENTAL AND EARTH SCIENCES

5574 (CONF-750576--1) INFLUENCE OF COLONIZING BENTHOS ON PHYSICAL PROPERTIES AND CHEMICAL DIAGENESIS OF THE ESTUARINE SEAFLOOR. Rhoads, D. C.; Aller, R. C.; Goldhaber, M. B. (Yale Univ., New Haven, Conn. (USA). Dept. of Geology and Geophysics; Geological Survey, Denver, Colo. (USA)). 1975. 45p. Dep. NTIS $5.25.

From symposium on ecology of marine benthos; Georgetown, South Carolina, USA (7 May 1975).

Two sampling stations were established on the top and edge of a newly dumped dredge spoil deposit in 12 and 18 meters of water in central Long Island Sound. These stations were sampled periodically from June 1974 to April, 1975. The spoil pile represents over $10^6 M^3$ of organic-rich sand, silt, and clay, dumped between October 1973 and April 1974. A control station was established 5.5 km NW from the dump in 14 meters of water. The colonization of the dump surface may be divided into three stages: Stage I (June-July) represents initial recruitment of shallow burrowing surface deposit feeders, suspension feeders, and meiofauna. Stage II (August-November) is a phase of exponential recruitment of stage I populations and new recruitment of deeper-feeding infauna. Stage III (December-April) is a period of leveling-off in population densities. The control station shows relative constant standing crops of deep-feeding deposit feeders over the sampling period. Late stage II and stage III abundances and diversities on the dump exceed those at the control station. Habitat modification related to the three colonization stages are: Stage I–Fecal pellet production starts and the redox potential discontinuity (RPD) is depressed to about one centimeter by feeding, bioturbation, and respiration activities. Stage II–The surficial layer of pellets experiences some destruction by meiofaunal grazing. The RPD is depressed to 2-3 cm and pore water profiles in SO_4^{2-} and NH_4 approach constant values to a depth of 3-6 cm. Sediment water content increases to 2-3 cm. The seafloor is bound by microbial exudates. Stage III - The pelletal surface decays, the RPD rebounds to a depth of 1-2 cm. Pore water profiles are diffusion-altered relicts of late summer irrigation activity. Microbial binding decreases. Several hypotheses are stated regarding the potential importance of these habitat modifications to the colonization sequence. (auth)

5575 DRIFT OF MACROINVERTEBRATES IN A CHANNEL CARRYING HEATED WATER FROM A POWER PLANT. Durrett, C. W.; Pearson, W. D. (North Texas State Univ., Denton). Hydrobiologia; 46: No. 1, 33-44(1975).

Hourly drift samples were collected once each month over a 24 hour period for 10 months at the mouth of a channel returning heated coolant water from a steam electric generating station to a 330 ha reservoir. Most benthic macroinvertebrates existed at lower densities on the bottom of the channel than in the reservoir. No organisms were found in the channel during summer months when water temperatures reached 42.2°C. The most abundant organisms drifting from the channel were Chaoborus larvae which probably were drawn from the reservoir, through the condensers of the power plant, and down the effluent channel. The maximum drift rate for Chaoborus larvae occurred in August ($8.91 \times 10_4$ mg/day) while the minimum rate occurred in December ($3.92 \times 10_2$ mg/day). Chaoborus larvae exhibited a diurnal periodicity in drift corresponding to their nightly emergence from bottom sediments in the reservoir. (auth)

5576 EFFECTS OF A POWER PLANT ON ZOOPLANKTON DISTRIBUTION AND ABUNDANCE NEAR PLANT'S EFFLUENT. Bauer, G. A.; Neill, W. H.; Magnuson, J. J. (Univ. of Wisconsin, Madison). Water Res.; 8: No. 7, 485-489(1974).

A power station on Lake Monona, Wisconsin, draws cooling water from two intakes 110M offshore and discharges the water at two shoreline outfalls 200M apart. The density of zooplankton near these outfalls was 2-7 times greater than at littoral reference stations because Zooplankton density at the limnetic intakes was consistently higher than in littoral reference areas. Thus, the circulation of cooling water transported zooplankton-rich water to the littoral zone. (auth)

5577 PROCEDURES USED TO EVALUATE THE THERMAL PROPERTIES OF SOILS ADJACENT TO BURIED EXTRA HIGH VOLTAGE LINES. Salomone, L. A.; Fischer, J. A.; Watson, I. (Dames and Moore, Cranford, NJ). J. Test. Eval.; 2: No. 6, 496-502(Nov 1974).

Because of the high voltages and operating temperatures now being considered for transmission lines from offshore generating stations, assessment of the thermal characteristics of the soils surrounding these cables is critical--both to avoid failure of the cables by overheating and to establish a practical engineering procedure to facilitate sound and economic cable designs in the future. A tridirectional approach used in a case history study to establish values of thermal resistivity along proposed offshore and onshore cable alignments is described. The procedural format developed is considered to have useful general application to this type of problem. Soils studied included clean sands and silty sands, silts, clays, and organic material (peat). (auth)

5578 CITIZENS' WORKSHOPS ON ENERGY AND THE ENVIRONMENT. Akers, L. K. (Univ. of Tennessee, Oak Ridge); Yegge, J. F. Nucl. Technol.; 27: No. 1, 143-147(Sep 1975).

The Citizens' Workshops on Energy and the Environment program was designed to heighten citizen awareness of the many dimensions of the energy problem. It involved the development of a novel educational device--the Energy-Environment Simulator--and appropriate visual materials for a general audience. The workshops have been presented more than 1500 times and in virtually every state of the union. (auth)

Minerals and Ores

Refer also to abstract 6884.

5579 SEARCH FOR SIGNS OF ACTIVITY OF CONTEMPORARY NATURAL ^{235}U NUCLEAR REACTORS. Prasolov, R. S. (Leningrad State Inst.). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 27-39(1974). (In Russian)

Supposition on the existence of modern natural nuclear reactors is formulated. This is possible because of nuclear reactor characteristic comparison on natural uranium with experimental geophysical data on volcanic and tectonik earthquakes. The first reactor was found in Gabon; it worked 1.7 million years ago. (auth)

5580 CURRENT URANIUM SUPPLY PICTURE. Nininger, R. D. (Energy Research and Development Administration, Washington, DC). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 29(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5581 RATIO OF THE CONTENTS OF URANIUM, THORIUM, AND POTASSIUM IN ACID VOLCANIC PRODUCTS AND THE PROBLEM OF IGNIMBRITES. Ditmar, G. V.; Maksimovskii, V. A. (Leningrad Geological Inst.). Dokl. Akad. Nauk SSSR; 219: No. 5, 1227-1230(11 Dec 1974). (In Russian)

From a knowledge of U, Th, and K distributions in ores it is possible to solve a number of problems in petrogenesis. It was found that acid tuffs and pumice are characterized by lower contents of U, Th, and K as compared to the content of these elements in lava minerals. It is concluded that the contents of U, Th, and K in vulcanoclastic ores are lower than in lavas. It was noted that the contents of U, Th, and K in ignimbrites were greater than the contents of these elements in lavas. Hence, the ignimbrites may be classified with the lavas in regard to their contents of U, Th, and K. (SJR)

Radioactivity Monitoring and Transport

Refer also to abstracts 5603 and 5820.

5582 (CONF-721244-1) PLUTONIUM CHEMISTRY OF THE OCEAN. Folsom, T. R. (Scripps Institution of Oceanography, La Jolla, Calif. (USA). Soledad Lab.). 14 Dec 1972. 8p. Dep. NTIS $4.00.

From ONR workshop on chemical oceanography; Monterey, California, USA (12 Dec 1972).

Plutonium is a man-made element whose behavior in the marine environment is inadequately known at present. It has been studied intensively in connection with production of weapons and power sources and has been characterized as an extremely toxic substance. Nevertheless, only a few dozen measurements have been made of concentrations in seawater and in the associated organisms and sediments. The first of these were as recent as 1964. There are reasons to believe its chemical behavior in the ocean is different from what has been observed on land, and that it will be difficult to predict how plutonium will distribute itself in the ocean. The consequences of increased environmental concentrations of Pu are discussed. (auth)

5583 (COO-2529-1) PLUTONIUM AND CESIUM RADIONUCLIDES IN THE HUDSON RIVER ESTUARY. Annual Technical Progress Report, December 1, 1974--November 30, 1975. Simpson, H. J.; Williams, S. C. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). 1975. Contract AT(11-1)-2529. 44p. Dep. NTIS $5.00.

We have obtained a large set of gravity cores from the Hudson Estuary through much of the ambient salinity range. A number of core sections have been analyzed for ^{137}Cs, ^{134}Cs, ^{60}Co, and ^{40}K by direct gamma counting, and for $^{239,240}Pu$ by alpha-spectrometry. The distribution of both ^{137}Cs and $^{239,240}Pu$ indicates rapid accumulation in marginal cove areas and in the harbor region adjacent to New York City. The distribution of both ^{137}Cs and $^{239,240}Pu$ in the sediments is quite similar in surface sediments, and the trends with depth in cores are also similar. The ratio of sediment $^{239,240}Pu$ to ^{137}Cs throughout the sampled salinity range (0-20 $^{0}/_{00}$) approximates that in fallout, except near the nuclear reactor at Indian Point where releases of ^{137}Cs result in a ratio lower (0.004 to 0.008) than typical of fallout (0.015). Measurement amounts of reactor-derived ^{134}Cs, ^{60}Co, and ^{54}Mn are found in nearly all of the samples containing appreciable ^{137}Cs. These samples were between 15 km upstream of Indian Point reactor site and the downstream extent of our sampling, 70 km south of the reactor. (auth)

5584 (DP-MS-75-73) EMERGENCY RESPONSE CAPABILITY FOR POLLUTANT RELEASES TO STREAMS AND RIVERS. Buckner, M. R.; Hayes, D. W.; Watts, J. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 17p. (CONF-751101-61). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Stream-river models have been developed which provide an accurate prediction of normal and accidental pollutant releases to streams and rivers. Stream parameters are being developed for the Savannah River Plant streams and the Savannah River to allow quick response in case of an accidental release of radioactive material. These data are stored on permanent disk storage for quick access via the JOSHUA operating system. This system provides an efficient and flexible emergency response capability for pollutant releases to streams and rivers. (auth)

5585 (LA-UR-75-2061) ACCUMULATION AND TRANSPORT OF SOIL PLUTONIUM IN LIQUID WASTE DISCHARGE AREAS AT LOS ALAMOS. Hakonson, T. E.; Nyhan, J. W.; Purtymun, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-Eng-36. (CONF-751105-7). Dep. NTIS $5.00.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Plutonium inventory estimates for the upper 12.5 cm of sediment in Mortandad Canyon, Los Alamos, New Mexico, did not reflect all the Pu added to the canyon during a 7 month interval. The methods used in this study indicate that about 2 mCi ^{238}Pu and 0 mCi $^{239,240}Pu$ were added to the canyon during the interval compared with known additions of 5.5 mCi ^{238}Pu and 0.4 mCi $^{239,240}Pu$. The discrepancy likely was the result of the large sampling variability indicating that inventory changes in this order (i.e., up to 17 percent) are not detectable with any certainty. However, factors other than sampling variability may be involved, including losses of plutonium to depths exceeding 12.5 cm. (auth)

5586 (ORNL-5002) BIOACCUMULATION FACTORS FOR RADIONUCLIDES IN FRESHWATER BIOTA. Vanderploeg, H. A.; Parzyck, D. C.; Wilcox, W. H.; Kercher, J. R.; Kaye, S. V. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 235p. Dep. NTIS $7.60.

This report analyzes over 200 carefully selected papers to provide concise data sets and methodology for estimation of bioaccumulation factors for tritium and isotopes of strontium, cesium, iodine, manganese, and cobalt in major biotic components of freshwater environments. Bioaccumulation factors of different tissues are distinguished where significant differences occur. Since conditions in the laboratory are often unnatural in terms of chemical and ecological relationships, this review was restricted as far as possible to bioaccumulation factors determined for natural systems. Because bioaccumulation factors were not available for some shorter-lived radionuclides, a methodology for converting bioaccumulation factors of stable isotopes to those of shorter-lived radionuclides was derived and utilized. The bioaccumulation factor for a radionuclide in a given organism or tissue may exhibit wide variations among bodies of water that are related to differences in ambient concentrations of stable-element and carrier-element analogues. To account for these variations, simple models are presented that relate bioaccumulation factors to stable-element and carrier-element concentrations in water. The effects of physicochemical form and other factors in causing deviations from these models are discussed. Bioaccumulation factor data are examined in the context of these models, and bioaccumulation factor relations for the selected radionuclides are presented. (auth)

5587 DISTRIBUTION AND CHARACTERIZATION OF PLUTONIUM IN SOILS FROM NEVADA TEST SITE. Tamura, T. (Oak Ridge National Lab., TN). J. Environ. Qual.; 4: No. 3, 350-354(1975).

Three surface soil samples, contaminated with plutonium by high explosive detonations of subcritical atomic devices at the Nevada Test Site (NTS), were analyzed for total plutonium content, plutonium distribution in different particle sizes, and leachability by HNO_3. Total plutonium averaged about 2,640 disintegrations per minute (dpm) per gram of soil. The highest concentration of plutonium in two samples taken from the same area was in the very fine sand (125-53 μm) fraction (38 and 47%); the third sample from another test area contained the highest concentration in the coarse silt (53-20 μm) fraction (47%). Leaching with 8M HNO_3 revealed that the extracted plutonium was related to the amount of plutonium associated with the finer sizes of soil particles. The highest extraction of 91% was associated with the sample containing 99% of the plutonium in particles < 125 μm; the lowest extraction (65%) with the lowest amount (55%) in the same size fractions. Density gradient separation of a silt and a clay fraction revealed that the plutonium in the silt size was associated with particles whose density was >2.8 g/cm^3; in the clay size the plutonium was associated with particles <2.2 g/cm^3. (auth)

5588 WORLD-WIDE ENVIRONMENTAL PROBLEMS. Wohlers, H. C. Tex. Rep. Biol. Med.; 33: No. 1, 1-23(1975.

Man and the physical and natural resources necessary to support him in a civilized society are on a collision course. It is simple to say that man cannot continue to grow in number at an ever-increasing rate without a destructive effect upon the environment. Positive scientific proof for this impending calamity is not now available, yet many indications--sometimes physical and sometimes natural--point toward major world-wide environmental troubles in the near future. A number of environmental problems are described, particularly as they relate to the total world system. A computer model simulating future world-wide environmental trends from 1900 to 2100 A.D. is evaluated and suggested as a major tool for data-gathering purposes to determine the extent of world-wide environmental problems. It is suggested that scientists take an active role in the study of the environment, particularly in relation to man's future on earth. (auth)

Atmosphere

Refer also to abstracts 5604, 5754, and 6070.

5589 (CONF-751043-1) DATA BASE OF THE ENVIRONMENTAL ASPECTS OF THE TRANSURANICS. Pfuderer, H. (Oak Ridge National Lab., Tenn. (USA)). 1975. Contract W-7405-eng-26. 7p. Dep. NTIS $4.00.

From workshop on the biological effects and toxicity of Pu 239 and Ra 226; Sun Valley, Idaho, USA (6 Oct 1975).

Indexed and abstracted references to the environmental aspects of the transuranium elements are entered into and are retrievable from a dynamic, computerized information file (or data base) that is easily modified to reflect changing research needs. The information is distilled from the documents with the specific needs of the researcher in mind, such as numeric results, new methods, or instrumentation. The major areas of evaluation are: biological and medical studies on the effects of the transuranics, particularly as these elements relate to health considerations in man; biological and ecological availability, turnover, and food chain dynamics; analysis of environmental materials; environmental transport mechanisms, including resuspension; waste disposal as related to environmental concerns; monitoring; and regulations and standards for environmental levels. Annotated references are indexed to allow easy access for retrieving references to documents of interest to the user. The goal is to furnish the users all the references related to their specific query and few that are unrelated. This is done by liberal use of subject categories and keyterms. The studies on man and animals are divided into the subject categories of medical and biological aspects. Those aspects that are considered important when the document is analyzed are tabulated. These data are sought for in the article,

included in the abstracts, and indexed with keyterms. This checklist is one of the ways the Data Base on the Environmental Aspects of the Transuranics strives to give users a reference to every paper in their subject area. (CH)

5590 (ERDA-tr-65) HOT AEROSOL PARTICLES ASSOCIATED WITH INDUSTRIAL ATOMIC ENERGY. Bykhovskii, A. V.; Zarnev, O. M. Oct 1975. Translation of Goryachie Aerozol'nye Chastitsy pri Tekhnicheskom Ispol'zovanii Atomnoy Energii, Atomizdat, Moscow, 1 February 1974. 209p. Dep. NTIS $7.60.

The broad range of problems associated with radiation safety in the case of contamination of the atmosphere by highly active aerosol particles is discussed. The modern concepts of radiation danger of aerosols, features of its assessment and monitoring, connected with the presence of radioactive particles in the composition of radioactive aerosol systems are presented. Also examined are the basic mechanisms by which radioactive aerosol particles are formed during the industrial utilization of atomic energy, particularly in nuclear reactors and large gamma-machines, and also during the recycling and processing of nuclear fuel. (554 references) (auth)

5591 (LA-UR--1915) ELEMENTS OF QUALITY ASSURANCE IN ENVIRONMENTAL SURVEILLANCE. Johnson, L. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 13p. (CONF-750967--17). Dep. NTIS $4.50.

From third ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

Qualities of an environmental surveillance program requiring control or assurance are reviewed. Requirements of accuracy, reproducibility, sensitivity, acceptability, and time and cost effectiveness are qualities discussed. The controls applicable to sample collection, handling, chemical analysis, measurement and data presentation are identified and discussed as they pertain to environmental monitoring. Quality assurance program recommendations for developing and reporting environmental surveillance data are provided. (auth)

5592 (UCCND-CSD-INF-64) STATISTICAL ANALYSIS OF ENVIRONMENTAL DATA. Beauchamp, J. J.; Bowman, K. O., Miller, F. L. Jr. (Oak Ridge National Lab., Tenn. (USA)). Oct. 1975. Contract W-7405-eng-26. 29p. Dep. NTIS $4.00.

This report summarizes the analyses of data obtained by the Radiological Hygiene Branch of the Tennessee Valley Authority from samples taken around the Browns Ferry Nuclear Plant located in Northern Alabama. The data collection was begun in 1968 and a wide variety of types of samples have been gathered on a regular basis. The statistical analysis of environmental data involving very low-levels of radioactivity is discussed. Applications of computer calculations for data processing are described. (CH)

5593 (UCRL-52000-75-8, pp 12-16) ENVIRONMENT AND SAFETY. ARAC: Real-Time Prediction of Hazards Due to Radioactive Releases. Aug 1975.

In Lawrence Livermore Laboratory energy and technology review. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The Atomospheric Release Advisory Capability (ARAC) is an ERDA-sponsored service designed to provide nuclear facilities with real-time predictions of the health hazards that might result from a release of radionuclides or other toxic materials. A two-laboratory feasibility study has proved the concept. LLL has built and is now operating a prototype ARAC component. ERDA plans to implement ARAC service at six of its nuclear facilities during the next three years. (auth)

Water

5594 SORPTION OF ^{239}Pu, ^{106}Ru, AND ^{99}Tc BY BOTTOM SEDIMENTS OF THE PACIFIC OCEAN. Gromov, V. V.; Spitsyn, V. I. Sov. Radiochem.; 16: No. 2, 157-162(1974).

Translated from Radiokhimiya; 16: No. 2, 157-162(1974).

An investigation was made of the absorption of microamounts of ^{239}Pu, ^{106}Ru, and ^{99}Tc by the most common sediments of the Pacific Ocean (deep sea red clay, carbonate sediment, diatomite ooze, and also hydrogenic sediment). It was established that red clay and carbonate sorb radioactive products most effectively. The radioactive isotopes studied may be arranged in the following sequence with respect to the degree of absorption: $^{106}Ru > ^{239}Pu > ^{99}Tc$. It was shown that in sea water several equilibrium physicochemical forms correspond to the given radioisotopes: ^{106}Ru has several sorbable forms, while ^{99}Tc evidently exists in the form of the difficultly sorbable anion TcO_4^- (the initial form added to the sea water). (auth)

Radiometric Techniques

Refer also to abstracts 5637 and 5640.

Site Surveys

5595 (CONF-751122-1) LAND USE SUITABILITY SCREENING FOR POWER PLANT SITES IN MARYLAND. Dobson, J. E. (Oak Ridge National Lab., Tenn. (USA)). 1975. 19p. Dep. NTIS $4.50.

From 30th annual meeting of the southeastern division of the Association of American Geographers; Pine Mountain, Georgia, USA (23 Nov 1975).

Since 1974 Oak Ridge National Laboratory (ORNL) has been engaged in developing an automated procedure for land use suitability screening. The Nuclear Regulatory Commission has funded the project to aid in the selection of power plant sites in Maryland. Its purpose is to identify candidate areas from which specific candidate sites can be chosen for detailed analyses. The ORNL approach assures that certain key variables are examined empirically for every cell in the study region before candidate sites are selected. Each variable is assigned an importance weight and compatibility score based upon its effect on the economic, social, or ecologic costs associated with construction in a given cell. The weighted scores for each variable are aggregated and output as a suitability score for each cell. (auth)

5596 (LA--6086--MS) EVALUATION OF YIELD AND WATER-LEVEL RELATIONS. Cushman, R. L.; Purtymun, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1975. Contract W-7405-ENG-38. 14p. Dep. NTIS $4.00.

Yield and water relations in the Los Alamos supply wells were evaluated because of the increasing demand for water. Water-level declines were extrapolated for 10 yr, to 1983, on the basis of past records. On the basis of current pumpage, the extrapolations indicate that nonpumping water levels in individual wells will decline from 10 to 30 ft. Well characteristics were compiled to provide an individual history of each well, and recommendations for improving water production are presented. (auth)

5597 (USGS-474-206) LITHOLOGIC LOGS AND STRATIGRAPHIC UNITS OF DRILL HOLES AND MINED SHAFTS IN AREAS 1 AND 6, NEVADA TEST SITE. Fernald, A. T.; Byers, F. M. Jr.; Ohl, J. P. (Geological Survey, Denver, Colo. (USA)). Oct 1975. Contract AT(29-2)-474. 69p. Dep. NTIS $5.45.

Lithologic logs for 21 drill holes and 2 mined shafts in Areas 1 and 6, Yucca Flat, Nevada Test Site, were compiled. All cores and cuttings were examined and, where available, geophysical logs were used to confirm contacts between stratigraphic units. (auth)

5598 (USGS-474-220) GEOLOGIC AND GEOPHYSICAL FIELD INVESTIGATIONS AT THE MINE THROW III SITE, SPLIT RIDGE, NEVADA TEST SITE, NEVADA. Cunningham, M. J.; Snyder, R. P. (Geological Survey, Denver, Colo. (USA)). Oct 1975. 85p. Dep. NTIS $5.45.

Geologic and geophysical field investigations were made at the Split Ridge Site of the Mine Throw III high-explosives experiment to determine the depth, uniformity, and physical properties of the rhyolite beneath the site. These data were necessary to predict the response of structures mined in the rhyolite to high-explosives detonated at the surface. Five exploratory holes were drilled at the site and continuously cored. Laboratory measurements of physical properties were made on the core. The rhyolite was found to average 67 metres in thickness, including a basal vitrophyre about 4 metres thick. Flowbanding, which is present throughout the major portion of the rhyolite, contains vesicles that weaken the rhyolite parallel to the flowbanding. Crosshole seismic surveys disclosed a horizontal velocity anisotropy of about 2.5 to 1 that is apparently related to regional stress. Refraction seismic surveys showed lateral velocity changes which rendered layered interpretation impossible. Uphole and crosshole seismic surveys made in the exploratory drill holes revealed that seismic velocities increase with depth through three intervals in the rhyolite. (auth)

Thermal Effluents

5599 EFFECTS OF TEMPERATURE–SALINITY COMBINATIONS ON THE FUNCTIONAL WELL-BEING OF ADULT LYTECHINUS VARIEGATUS (LAMARCK) (ECHINODERMATA, ECHINOIDEA). Lawrence, J. M. (Univ. of South Florida, Tampa). J. Exp. Mar. Biol. Ecol.; 18: 271-275(1975).

The activity coefficient (1000/righting time in sec) was measured to indicate the functional state of Lytechinus variegatus (Lamarck) after exposure to combinations of temperature (22°, 28°, and 34°C)

and salinity (25, 30, 35, and 40‰). Environmental levels of these variables were 30–33°C and 34–35‰. The results indicate that the species lives closer to the upper than lower lethal limits of temperature and salinity. The maximal activity coefficient (18 ± 8) was at 28°C and 35‰. A reduction in salinity was probably responsible for a recent mass mortality of the echinoid reported in the eastern Gulf of Mexico. (auth)

5600 EMERGENCE OF INSECTS FROM A BRITISH RIVER WARMED BY POWER STATION COOLING-WATER. I. The Use and Performance of Insect Emergence Traps in a Large, Spate-River and the Effects of Various Factors on Total Catches, Upstream and Downstream of the Cooling-Water Outfalls. Langford, T. E.; Daffern, J. R. (Scientific Services Center, Ratcliffe-on-Soar, Eng.). Hydrobiologia; 46: No. 1, 71-114(1975).

During a program of research on the fauna of the River Severn around Ironbridge Power Station, the emergence patterns of resident insect species were studied upstream and downstream of the cooling-water outfalls. The traps used to catch emerging adult insects are described and their overall performance, total catches and species selectivity are related to the physical characteristics of the river. (auth)

5601 WIND EROSION OF HEATED SURFACE LAYER. Wu, J. (Univ. of Delaware, Newark). Water Res.; 9: No. 11, 1005-1007(Nov 1975).

The natural dilution and dissipation of heat introduced by thermal discharges into water bodies can be divided into a thermal plume near ejection site, a thermal current at near field, and a nearly well-mixed region at far field. Wind erosion of the thermal layer of the thermal current is discussed. The warm-water layer formed near the water surface is generally considered to reach an equilibrium thickness, at which the lower boundary of the layer becomes stable with negligible mixing. The equilibrium state may hardly exist as the mixing induced by the wind continuously deepens the heated surface layer. Some typical values of layer thickness and temperature difference are chosen for illustrating wind erosion of heated surface layer. The thickening of, and the mixing within, the surface layer causes a reduction in the surface temperature; the heat loss to the air through conduction may therefore be reduced. As hot water penetrates deeper, the bottom sanctuary may not exist, some changes may be required to coordinate the situation, especially during storms. (FMM)

5602 SPECIES, SIZE, AND AGE DISTRIBUTION IN NORTHERN DONETS FISHES IN THE AREA OF DISCHARGE OF WARM-WATER EFFLUENTS FROM THE LUGANSK POWER STATION. Schcherbukha, A. Ya. (Instytyt Zoologii, Kiev). Hydrobiologia; 9: No. 3, 36-41(1973).

The changes in the species composition of the ichthyofauna of the nothern donets in the region of discharge of the warm water from the Lugansk Power Station are described. A relationship is demonstrated between the species of fish, their size, and their age in commercial catches. Measures are described for restoring stocks of fish in this sector of the river. (auth)

Chemical Effluents

Refer also to abstract 5754.

5603 (BNWL-SA-5571) SAMPLING THE ENVIRONS FOR CONTAMINATION. Eberhardt, L. L.; Gilbert, R. O. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 11p. (CONF-751113-8). Dep. NTIS $4.50.

From 1st ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

Many contaminants may exhibit a highly dynamic behavior in both abiotic (atmosphere, water, and soil) and biotic systems and various kinds of mathematical models for that behavior have been developed. Guidance is lacking for the design of a sampling program for the study of a trace substance (contaminants) in any system. Because contaminants are seldom found to be uniformly spread over the landscape, it was concluded that sampling programs should be designated to fit the needs of each study. (CH)

5604 (UCRL-52000-75-8) LAWRENCE LIVERMORE LABORATORY ENERGY AND TECHNOLOGY REVIEW. Carr, R. B.; Barnett, J. M.; Berlo, R. C.; McCaleb, C. S.; Prono, J. K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1975. Contract W-7405-Eng-48. 24p. Dep. NTIS $4.00.

Separate abstracts were prepared for four sections of this report, two of which appear in Nuclear Science Abstracts and two in ERDA Research Abstracts. (CH)

For abstracts of individual sections see: 4971 and 5593.

5605 ENERGY COST OF POLLUTION CONTROL. Hirst, E. (Oak Ridge National Lab., TN). Environment; 15: No. 8, 37-44 (Oct 1973).

This study indicates that the energy needed for operating environmental controls would be small and could be almost offset by several energy-saving tactics. Over-all programs are examined, using certain basic hypothesis. Energy costs and savings are calculated for specific scenarios in transportation, waste disposal, manufacturing, and pollution control. (JMC)

5606 COMPARATIVE MEASUREMENTS OF MERCURY CONCENTRATIONS IN THE COATZACOALCOS RIVER'S ESTUARY USING NAA AND AAA. Baez, A. P. (Instituto Nacional de Energia Nuclear, Mexico City); Galvez, L.; Tzontlimatzin, E. Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 55(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 4975, 6730, and 6860.

5607 (JINR-R9-7339, pp 298-304) AUTOMATIC VIEWING APPARATUS FOR CHARGED PARTICLE TRACKS IN A NUCLEAR PHOTOEMULSION. Shkaba, V.; Bauer, R.; Svoboda, Z. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Special features are described of the system for recording data made with a multi-angle magnetic analyzer for the analysis of the products of nuclear reactions. The spectra are recorded with a 50-μm-thick nuclear photoemulsion. The principle of operation and special features of an automatic device for examining nuclear photoemulsions are described. A scheme is presented which illustrates the mechanics and optics of the equipment. (INIS)

5608 NEW GAMES WITH OLD DETECTORS. Old Games With New Detectors. CERN Cour.; 15: No. 6, 183-188(Jun 1975).

The operation, development, and uses of drift chambers are reviewed. Topics include drift chambers in proton radioscopy; drift chambers for x-ray, neutron, and γ detection; drift chambers for studying channeling and blocking in crystal lattices; and the scintillating drift chamber. (WHK)

5609 MEASUREMENT OF THE RATIO BETWEEN THE AMPLITUDES OF LIGHT PULSES AND THE LINEARITY OF A PHOTOELECTRON MULTIPLIER BY MEANS OF A STROBOSCOPIC OSCILLOSCOPE. Bushnin, Yu. B.; Krasnokutskii, R. N., Mikhailov, Yu. V., Morozov, V. N.; Shuvalov, R. S. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 566-568(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 190-191(1975).

In experiments using scintillation and Cerenkov particle detectors it is sometimes necessary to measure the amplitude of nanosecond light pulses relative to a certain standard amplitude. A method is described for measuring the ratio between two light pulses which differ in intensity by a factor of 10 to 300 with an accuracy of 2 to 3%. The method is based on using the power-law dependence of the gain of a photoelectron multiplier (p.e.m.) on the high voltage applied to the p.e.m. This dependence was likewise used to measure the maximum linear current of a p.e.m. (auth)

5610 NOISE OF LOAD RESISTOR IN PREAMPLIFIERS FOR SEMICONDUCTOR DETECTORS. Baldin, S. A.; Bairamashvili, I. A.; Gubin, S. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 493-495(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 135-138(1975).

The principal reasons are examined for a deterioration in the energy resolution of preamplifiers used for semiconductor detectors (SCD) containing a resistor in the feedback loop. A comparison is made between the noise characteristics of various high-ohmic commercial and experimental resistors. It is shown that the resistor noise depends on the character of the decrease of the ohmic part of the resistor impedance in the region up to 100 kHz, and also on the stray capacitance of the resistor. (auth)

5611 NARROW-BAND X-RAY DETECTOR. Anisovich, K. V.; Komyak, N. I. (Special Design Office for X-Ray Apparatus, Lenigrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 599-601(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 216-218(1975).

A narrow-band x-ray detector for the energy range 5 to 80 keV is described. The detector passband is 0.3 to 2 keV and the detection efficiency can be as high as 12%. An example of the use of the detector in x-ray spectral analysis is given. (auth)

5612 EFFECTS OF AN ELECTRIC FIELD ON THE EMISSION PRODUCED FROM A LIQUID SCINTILLATOR BY IONIZING RADIATION. Nozdrin, A. A.; Shelkov, G. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 630(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 239(1975).

From a previous study on the effects on an electric field on individual scintillation in organic scintillators it is known that a steady field up to 100 kV/cm does not influence the intensity of the liquid-scintillator output on exposure to ^{60}Co γ rays, but rapidly changing fields reduce the pulse amplitude, while increase or decrease in field strength by 70 to 80 kV/cm produces complete scintillation quenching, which occurs within about 1 sec, and then the effect recovers. The effects of steady and pulsed electric fields on the scintillation amplitude produced by α and γ rays in a standard toluene-based liquid scintillator was studied. Results are presented. (auth)

5613 AMPLIFIERS FOR COSMIC-RAY NEUTRON SUPERMONITORS AND SUPERTELESCOPES. Lyutenko, V. F.; Starodubtsev, A. M.; Upol'nikov, A. A.; Chirkov, N. P. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 488-490(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 132-134(1975).

Two amplifier-discriminator circuits are described which have a high stability of the actuation threshold (+2%) for small dimensions in a wide range of input amplitudes ($5 \cdot 10^{-3}$V-1 V) and temperatures (−40 to +20°C.) They are designed for cosmic-ray pickups in large proportional counters which are in continuous operation for many years. (auth)

5614 STUDY ON THE GERMANIUM RADIATION DETECTOR COMPENSATED BY GAMMA-RAY IRRADIATION. Moon, P. S. (Korean Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 7: No. 2, 85-94(Jun 1975).

Some n-type germanium crystals have been irradiated by ^{60}Co gamma-ray with 647 Mrad at room temperature for compensation. The Ge(γ) detectors were fabricated from the gamma-ray irradiated germanium single crystals. The detector characteristics of the Ge(γ) detectors were comparable to those of thin Ge(Li) detectors and high purity germanium detectors. The thermal stability of the Ge(γ) detector showed a feasibility for ambient temperature storage. (auth)

5615 PHOSPHORESCENCE IN DIFFERENT COUNTING VIALS USING A SCINTILLATION COUNTER WITH ONLY ONE PHOTOMULTIPLIER. Bermudez, T. (CNIC, Havana). Rev. CENIC, Cienc. Fis.; 5: No. 2, 259-270(1974). (In Spanish).

When working with a liquid scintillation counter using only one photomultiplier, some difficulties may arise because of the phosphorescence produced by light (especially day or fluorescent light) on the glass of the counting vials, and because of a lack of information as to the optimum time necessary for background as well as active samples to return to their normal counting levels. A study is described with a spectrometer NE-8305 (with only one phototube), using three different types of glass counting vials: normal, coated and quartz-bottomed, the last aluminized and coated. Active samples of ^{14}C and two types of liquid scintillators, one based on Dioxane (Bray's) and the other on Toluene have been used. Data tabulation as well representative graphs of the gradual decay of phosphorescence are presented. In addition, a statistical analysis of the percentages of variation of the counts is made to show the optimum decay time that should be taken into account for both background and active samples to obtain a correct count when this work is being done in a laboratory that is using daylight or fluorescent light. (auth

5616 CALIBRATION AND APPLICATIONS OF SOLID DETECTORS FOR RECORDING CHARGED-PARTICLE TRACKS. Segovia, N.; Salinas, B.; Romero, M. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 54-55(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5617 RADIATION IMAGING: AN INTERESTING UTILIZATION OF NUCLEAR ENGINEERING METHODOLOGY. Kenney, E. S.; Jacobs, A. M. (Pennsylvania State Univ., University Park). Nucl. Technol.; 27: No. 1, 67-77(Sep 1975).

Using well-established nuclear engineering methods, an interesting new radiation imaging technique has been developed. Scattered neutrons and photons have been found to carry detailed information about the dynamics of the internal structure of an opaque object. Employing coded apertures and systems of collimators, scattered radiation fields have been examined to determine the extent and quality of the image information carried on these fields. A medical application of the results of this research has shown that movements of the myocardial surface can be detailed for diagnostic purposes. The success of this research effort substantiates the belief that nuclear engineering educational groups should more fully explore their own potential for growth and contribution in neighboring disciplines. (auth)

5618 SILICON SPECTROMETRIC NUCLEAR PARTICLE DETECTOR AS A LINEAR p-i-n DETECTOR OF SHORT LIGHT SIGNALS. Konova, A. A.; Dinev, S. S.; Gospodinov, M. M. (Univ., Sofia). C. R. Acad. Bulg. Sci.; 28: No. 5, 597-599(1975). (In Russian)

The optical characteristics of a silicon detector with p-i-n structure and used as a detector of nuclear particles with a long mean free path were measured. The dependence of the short-circuit current was measured as a function of the illumination. The dependence of the open-circuit voltage was also measured as a function of the illumination. The experimental data showed that these Si detectors are not only good nuclear particle spectrometric detectors but are very ideal photocollectors transforming stably and linearly light signals into electrical signals with a response speed of at least 2 to 5 nsec. (JSR)

Radiation Dosimeters

5619 (BNWL-1934) FIFTH ERDA WORKSHOP ON PERSONNEL NEUTRON DOSIMETRY. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 72p. Dep. NTIS $5.45.

Separate abstracts were prepared for 5 of the 15 papers presented. The 10 remaining papers were summaries of neutron dosimetry research work at various laboratories. (WHK)

For abstracts of individual papers see: 5620–5624.

5620 (BNWL-1934, pp 12-19) NEUTRON DOSE MEASUREMENTS BY ELECTROLYTIC CONDUCTANCE IN FISSION FRAGMENT DAMAGE TRACKS. Cross, W. G.; Ing, H. (Atomic Energy of Canada Ltd., Chalk River). 1975.

In fifth ERDA workshop on personnel neutron dosimetry. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The density of fission fragment damage tracks in a plastic foil exposed to neutrons against a radiator of fissionable material has been used for a number of years for determining neutron doses. Of the methods that have been developed for determining the number of tracks without having to count these under the microscope, spark counting appears to be the simplest and most accurate, providing that the track density is not too high. The very simple alternative method described is intended primarily for higher track densities than can be measured by spark counting. It depends on filling the etched tracks that penetrate the foil with electrolyte and measuring the electrical conductance through them. (WHK)

5621 (BNWL-1934, pp 20-31) CALIBRATION OF THE EXPERIMENTAL BND PERSONNEL NEUTRON DOSIMETER FOR GENERAL USE. Distenfeld, C. (Brookhaven National Lab., Upton, NY). 1975.

In fifth ERDA workshop on personnel neutron dosimetry. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The experimental Brookhaven neutron dosimeter, BND, is a composite damage track and thermoluminescent detector. Thorium fission is used to respond to greater than 1 MeV and high sensitivity TLD 600 and 700 ribbons respond to softer neutrons. Previous experimental work at the Alternating Gradient Synchrotron, AGS, a 33 GeV proton accelerator, utilized the energy dependence of the ratio of thermoluminescent to thorium response, softness. Softness variation was related to a correction factor used to adjust a TLD response to properly account for the dose equivalent. An invitation was extended to participate in the 1974 Intercomparison of Personnel Neutron Dosimeters. The Oak Ridge National Laboratory study was similar to the standard nuclear accident dosimetry intercomparisons, but of lower dose magnitude. Neutron spectra of varying composition were generated by a 14 MeV neutron generator and the HPRR reactor in its three configurations. Participation in the study required the determination of different BND calibration constants for the much softer reactor spectra. The resulting study assumed that the high energy accelerator constants were properly specified. All remaining field spectra were assumed to be limited to approximately 15 MeV. For this case, the thorium calibration value was 7.1 mrem x sparks^{-1} and the problem was the interpretation of the TLD response. Results are presented. (WHK)

5622 (BNWL-1934, pp 43-53) STUDIES OF NEUTRON DOSIMETRY AT THE LAWRENCE LIVERMORE LABORATORY. Hankins, D. E. (Univ. of California, Livermore). 1975.

In fifth ERDA workshop on personnel neutron dosimetry. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The evaluation of neutron exposures from LLL personnel TLD badges is discussed; and data are given and discussed on the calibration factors for albedo-neutron dosemeters as a function of the dose rate at various facilities. (WHK)

5623 (BNWL-1934, pp 54-57) RESPONSE OF SAVANNAH RIVER THERMOLUMINESCENT NEUTRON DOSIMETER TO MONOENERGETIC NEUTRONS. Hoy, J. E.; Hall, R. M. (E. I. du Pont de Nemours and Co., Aiken, SC). 1975.

In fifth ERDA workshop on personnel neutron dosimetry. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

The Thermoluminescent Neutron Dosimeter (TLND) is an albedo-type detector designed to respond in a manner approximately proportional to the dose equivalent. The dosimeter was intended to be used in a normal working environment where a complete spectrum of neutron energies occur and where monoenergetic neutrons are practically nonexistent. However, knowledge of the response of dosimeters to monoenergetic neutrons can assist in understanding the observed response to continuous spectra. (WHK)

5624 (BNWL-1934, pp 58-59) NTA PROTON RECOIL TRACK FADING IN PERSONNEL NEUTRON DOSIMETRY. Phillips, L. F. (Brookhaven National Lab., Upton, NY). 1975.

In fifth ERDA workshop on personnel neutron dosimetry. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)).

Two Kodak NTA proton track fading studies were performed using two different types of sealing packets and storage at 100 percent relative humidity (R.H.). Results are summarized graphically. (WHK)

5625 (CEA-R-4697) CONTRIBUTION TO THE STUDY AND DEVELOPMENT OF RADIOTHERMOLUMINESCENT DOSIMETRY. Portal, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). Oct 1975. 214p. (In French). Dep. NTIS (US Sales Only) $7.75.

Thesis. Submitted to Univ. of Toulouse.

The applications of radiothermoluminescence to radiation dosimetry were investigated. The fundamental processes are first reviewed and the main properties of radiothermoluminescence dosemeters are stated. The investigations carried out in order to have materials presenting particular dosimetric characteristics are then described: a lithium fluoride stabilized by sodium that can be reused without regeneration and alumina suitable for dosimetry in case of accident. Finally, the measurement of electromagnetic radiation in the presence of neutrons of various energies are considered. (auth)

Nuclear Spectroscopic Instrumentation

5626 (EGG-1183-5051) DESIGN, CONSTRUCTION, AND CALIBRATION OF A NONFOCUSING NEUTRON SPECTROMETER. Storey, W. (EG and G, Inc., Albuquerque, N. Mex. USA)). Dec. 1974. Contract AT(29-1)-1183. 139p. Dep. NTIS $5.45.

For Los Alamos Scientific Lab., NM.

A fourteen-channel time-resolved neutron spectrometer with associated Faraday cup has been designed and constructed for use in the field. A neutron energy range of 9.5 to 15 MeV is covered. Both instruments detect protons elastically scattered from a thin hydrogenous foil in interaction with the neutron beam, with magnetic analysis of the protons by the spectrometer. The design requirements of small size and weight and 0.6 to 0.7 MeV resolution have been met. Following a description of the instrument and of its geometry, there is a detailed presentation of the design and construction of the instrument. The section on instrument performance is concerned with the comparison between predicted performance based upon computation, in which the magnet is of primary interest, and upon measured performance based upon a calibration experiment, which is given a general description in Appendix A. Software used mainly for signal prediction and unfolding, for both the neutron spectrometer and Faraday cup, is described. (WHK)

5627 (VTT-REA-31) REVERSE TIME-OF-FLIGHT TEST FACILITY FOR NEUTRON DIFFRACTION STUDIES. Hiismaeki, P.; Junttila, J.; Piirto, A. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). Aug 1974. 23p. Dep. NTIS (US Sales Only) $4.50.

A description is given of an experimental test facility aimed at obtaining practical experience on the reverse time-of-flight techniques. Special attention is paid to the computer based data processing system and the construction of a Fourier chopper operated at a maximum speed of 7000 r.p.m. corresponding to 100 kHz modulation of the neutron beam. Test measurements on single crystals are reviewed confirming the expected relative widths of the order of 0.1% for the diffraction peaks. Finally various aspects of a reverse time-of-flight diffractometer are discussed. (auth)

5628 SPECTROMETRIC GAMMA DETECTORS, BASED ON CADMIUM TELLURIDE CRYSTALS. Arkad'eva, E. N.; Maslova, L. V.; Matveev, O. A.; Prokof'ev, S. V.; Ryvkin, S. M.; Khusainov,

A. Kh. (Ioffe Inst. of Physics and Tech., Leningrad). Dokl. Akad. Nauk SSSR; 221: No. 1, 77-80(1975). (In Russian)

Semiconducting CdTe single crystals of a p-type were grown from a melt under controlled conditions. The hole concentration at room temperature varied from 6×10^7 to 7×10^8 cm^{-3}, and the mobility μ was found to be 10 to 40 cm^2/v. sec. The CdTe single crystals were encased in Al or Au to create a gamma detector. The thickness of the sensitive region of the crystals was 0.5 to 3 mm. The working area of the detector was 0.1 to 0.5 cm^2. Short constant formation time was used in the network to improve the ratio of signal to noise and to correct for the strong asymmetry in the mobility of the charge carriers. With a 1 mm thickness in the sensitive region, CdTe crystals from batch 83 A showed a resolution of <2% (11 to 13 keV) for 662 keV line of Cs-137. In the region of low energies the resolution is determined by current noise. For Co-57 gamma quanta the best resolution was 4.6 keV. By decreasing the dark current of the detector it was possible to increase the resolution considerably. Polarization effects could not be observed because of the high quality of the crystal preparation. (SJR)

5629 LOW-NOISE PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS WITH OPTOELECTRONIC FEEDBACK. Lyk, H. D. (Hanoi Inst. of Physics, North Viet Nam). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 491-492(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 134-135(1975).

A low-noise preamplifier with optoelectronic feedback for an x-ray spectrometer is described, and an electronic resolution of 350 eV has been obtained when the field-effect transistor in the principal part of the preamplifier is cooled. (auth)

5630 MULTIDIMENSIONAL USE OF AI-1024 AND AI-4096 PULSE-HEIGHT ANALYZERS. Zaika, N. D.; Kovtunenko, I. S.; Savchuk, O. G. (Inst. of Technical Physics, Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 635-637(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 243-245(1975).

γ-ray energy spectra are recorded in several sequential time intervals in examining short-lived isomeric nuclear states. If several different half-lives are to be observed simultaneously, one has to be able to adjust the lengths of the intervals. This means that the multichannel analyzer must work in the pulse-height mode over various time intervals in each group, while one must have available intervals less than 100 μsec. In some cases one has to record spectra simultaneously from several counters with varying time division, as in measuring total internal-conversion coefficients. Existing multichannel analyzers do not provide these modes of operation. A description is given of multichannel pulse-height analyzers operating in the following multidimensional modes: the AI-1024-4 in the amplitude mode from several transducers, and also in the amplitude mode from several transducers with time sharing, and the AI-4096-3M in the amplitude mode in time intervals different for four different groups with a BVI-1 unit. (auth)

5631 X-RAY AND SOFT γ RADIATION SPECTROMETER PREAMPLIFIER WITH DRAIN FEEDBACK. Khomyakov, G. K.; Serykh, N. V.; Strashinskii, A. G.; Skakun, N. A. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 496-497(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 138-140(1975).

A low-noise spectrometric preamplifier is described using a type KP303G field-effect transistor in a novel feedback arrangement. An energy resolution of 290 eV at the ^{57}Co 6.399 keV line has been obtained using an Si(Li) drift detector with 0.77-pF capacitance and 10^{-13}-A leakage current. (auth)

5632 PROPORTIONAL-COUNTER SPECTROMETRY. Fink, R. W. (Georgia Inst. of Tech., Atlanta). pp 169-186 of Atomic Inner-Shell Processes. Vol. 2. New York; Academic Press, Inc. (1975).

Although proportional counters have been supplanted by semiconductor detectors for photon spectroscopy in the energy region above a few kiloelectron volts, except for gaseous radioactive sources or gaseous targets, they remain the primary instrument at lower energies extending down to the measurement of single electrons of essentially zero energy. They also remain the premier instrument for absolute photon intensity measurements up to approximately 100 keV and, indeed, serve to calibrate absolute photon intensities against which the semiconductor detectors are efficiency calibrated. One- and two-directional position-sensitive proportional counters are finding new applications in nuclear physics and for x-ray and neutron imaging. The field of application of position-sensitive proportional counting is developing rapidly, and many new uses and developments are being reported. (auth)

5633 $4\pi\beta-\gamma$ AND $4\pi(x,e)-\gamma$ COINCIDENCE METHOD WITH LIQUID SCINTILLATION COUNTER FOR COUNTING β-PARTICLES, AUGER-ELECTRONS OR X RAYS. Chylinski, A.; Radoszewski, T. (Radioisotope Production and Distribution Centre, Swierk, Poland). Nukleonika; 20: No. 5, 469-482(1975).

The new version of $4\pi\beta-\gamma$ and $4\pi(x,e)-\gamma$ coincidence method has been presented with a $\beta(x,e)$-counting channel made of a double scintillation head, with liquid scintillator working in coincidence. Thus the triple scintillation head has been applied with a NaI(Tl) crystal in the γ-counting channel, and with the two stage coincidence unit. Theoretical evaluation of the new version has been made, and measurements of radioactive concentration of three nuclides have been performed. There were $\beta-\gamma$-emitters (Co-60 and Nb-95), and E.C. nuclides (Cr-51) as well. The results are compared to the figures obtained from the classical $4\pi\beta-\gamma$ coincidence method with a proportional counter in the β-channel. The possibility of application of the proposed version for counting of pure β-emitters using a tracer technique is pointed out. (auth)

High Energy Physics Instrumentation

5634 VACUUM-TIGHT COMPRESSOR. Bogmolova, L. K.; Vasilenko, A. T. (Joint Institute of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 551-553(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 180-182(1975).

A vacuum-tight compressor whose construction eliminates leakage of the pumped circulating medium and intake of the external medium for circulation of the gases in spark chambers or streamer chambers is described. There is practically no contamination of the pumped circulating medium. The maximum air productivity is 262.6 liters/h at 24°C and an absolute pressure of 1.4 atm at the outlet; the minimal productivity is 82.6 liters/h at 24°C and an absolute pressure of 1.4 atm at the outlet; under these conditions the pressure at the inlet is equal to 1 atm. The drive is electromagnetic. The compressor is supplied from a special current source which produces rectangular pulses with a controllable repetition frequency. (auth)

5635 STUDY OF GRAIN-SIZE DISTRIBUTION-PARAMETERS IN ILFORD G-5 EMULSIONS. Kumar, V.; Sharma, A. P. (Kurukshetra Univ., India). Indian J. Pure Appl. Phys.; 13: No. 6, 424-426(Jun 1975).

A comparative study of size distribution of AgBr grains in unprocessed and Ag grains in processed Ilford G-5 emulsion is made, and the distribution parameters are evaluated. The statistical analysis shows a highly skewed and leptokurtic distribution of grains of silver along the tracks of minimum ionization π^- beam particles (momentum = 4 GeV/c). The peakiness and skewness are also explained. (auth)

Radiometric Instruments

Refer also to abstract 4976.

5636 (BDX-613-1284) EVALUATION OF THE X-RAY FLUORESCENCE METHOD OF PRECIOUS METAL PLATING THICKNESS MEASUREMENTS. Technological Spinoff Report. Carson, J. S.; Hearn, N. K.; Pettie, C. B. (Bendix Corp., Kansas City, Mo. (USA)). Sep 1975. Contract AT(29-1)-613. 41p. Dep. NTIS $5.00.

It is shown that gold and silver plating thickness measurements made using an x-ray spectrograph could be closely correlated with thicknesses measured from sectional samples. Good correlations were also shown for single overlays of gold over silver when each layer was less than 0.0003 inch thick. (auth)

5637 METHODS AND APPARATUS FOR MEASURING THE DENSITY OF GEOLOGICAL FORMATIONS. Seeman, B. (to Schlumberger Canada Ltd.). Canadian Patent Application 161,283. 15 Jan 1973. Priority date 19 Jan 1972, France. vp.

The present invention relates to a method for correcting the effects of barite contained in the mudcake of a borehole on the count rate of pulses delivered by the main detector of a gamma-ray tool used for measuring the density of the geological formations traversed by the borehole from the count rate of the pulses having an amplitude higher than a given threshold. This threshold is called the count threshold. The method includes the steps of determining the deformations due to barite in the amplitude spectrum of the pulses from the detector and modifying the count threshold so that the measured count rate is not influenced by these deformations. The invention also includes an apparatus. The apparatus is comprised of means for determining the deformations due to barite in the amplitude spectrum of the detector pulses and adjusting means which are responsive to the means for deter-

mining the count threshold so that the measured count rate is not influenced by these deformations. (Patent Office Record)

5638 PERMEABILITY LOG USING NEW LIFETIME MEASUREMENTS. Dowling, D. J.; Boyd, J. F.; Fuchs, J. A. (to Texaco Inc.). US Patent 3,890,502. 17 Jan 1975. Filed date 20 Dec 1973. 6p.

Comparative measurements of thermal neutron decay time are obtained for a formation after irradiation with a pulsed neutron source. Chloride ions in formation fluids are concentrated by the electrosmosis effect using charged poles on a well logging sonde. The formation is irradiated with fast neutrons and a first comparative measure of the thermal neutron decay time or neutron lifetime is taken. The chloride ions are then dispersed by acoustic pumping with a magnetostrictive transducer. The formation is then again irradiated with fast neutrons and a comparative measure of neutron lifetime is taken. The comparison is a function of the variation in chloride concentration between the two measurements which is related to formation permeability. (auth)

5639 METHOD AND APPARATUS FOR LOGGING WELL BOREHOLES WITH GAMMA RAYS FROM THE INELASTIC SCATTERING OF FAST NEUTRONS. Culver, R. B. (to Dresser Industries, Inc.). US Patent 3,886,355. 27 May 1975. Filed date 3 Oct 1972. 16p.

A fast neutron source is periodically switched between a pulsed mode and a continuous mode. A first gamma ray detection interval follows the pulsed mode to provide an indication of the capture gamma rays. A second detection interval occurs during the continuous mode to provide an indication of the capture gamma rays plus the gamma rays resulting from the inelastic scattering of fast neutrons. The first indication is subtracted from the second, resulting in an indication solely of the gamma rays from inelastic scattering. The pulses occurring in such intervals are further subjected to energy discrimination which provides information relating to carbon and oxygen content, such information being used with a ratio circuit to provide a carbon/oxygen ratio. In another embodiment, a pair of neutron sources, one pulsed, one continuous, provide analogous results. In still another embodiment, the borehole is first logged with a pulsed source and then later with a continuous source. In yet another embodiment, a shielding, rotating disk having alternate short and long windows is used between an alpha particle source and a neutron emitter to simulate the pulsed and continuous modes. An electrical signal functionally related to the lithology of the formations, for example, the silicon/calcium ratio of the formations, is used in conjunction with an electrical signal indicative of the carbon/oxygen ratio to generate an electrical signal indicative of the hydrocarbon saturation of the formations. (auth)

5640 METHODS AND APPARATUS FOR MEASURING THE DENSITY OF GEOLOGICAL FORMATIONS. Seeman, B. (to Schlumberger Technology Corp.). US Patent 3,900,733. 19 Aug 1975. Priority date 24 Jan 1972, France. 18p.

A tool for measuring the density of the geological formations traversed by a borehole is described. An apparatus corrects the effects of barite on the count rate of the pulses which are used for the density measurement and have an amplitude higher than a given threshold by determining the deformations in the amplitude spectrum of these pulses and adjusting this threshold so as to compensate by the variation in the number of pulses taken into account resulting from the adjustment for the variation in the number of counted pulses resulting from the said deformations. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

5641 (SAND-75-5731) CMOS OPTIMIZATION FOR RADIATION HARDNESS. Derbenwick, G. F.; Fossum, J. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 4p. (CONF-751206-1). Dep. NTIS $4.50.

From IEEE international electron devices meeting; Washington, District of Columbia, USA (1 Dec 1975).

Several approaches to the attainment of radiation-hardened MOS circuits have been investigated in the last few years. These have included implanting the SiO_2 gate insulator with aluminum, using chrome-aluminum layered gate metallization, using Al_2O_3 as the gate insulator, and optimizing the MOS fabrication process. Earlier process optimization studies were restricted primarily to p-channel devices operating with negative gate biases. Since knowledge of the hardness dependence upon processing and design parameters is essential in producing hardened integrated circuits, a comprehensive investigation of the effects of both process and design optimization on radiation-hardened CMOS integrated circuits was undertaken. The goals are to define and establish a radiation-hardened processing sequence for CMOS integrated circuits and to formulate quantitative relationships between process and design parameters and the radiation hardness. Using these equations, the basic CMOS design can then be optimized for radiation hardness and some understanding of the basic physics responsible for the radiation damage can be gained. Results are presented. (WHK)

5642 (UCID-16945) FINAL REPORT FOR EMP INSTRUMENTATION PROJECT DNA IACRO 75-815: MAGNETIC THIN FILM SENSORS. Hsieh, E. J.; Miller, D. E.; Vindelov, K. E.; Brown, T. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1975. Contract W-7405-Eng-48. 26p. Dep. NTIS $5.00.

The magnetic thin film current sensor/recorder is a passive device which responds to the peak current and pulse shape of a transient event. The transient current information becomes a permanent record on the film. The thin film device is small, low mass and reusable. It has been proven to be fast (less than 1/2 nanosecond response), radiation hard and applicable to peak current measurement of both CW and pulsed signals. The sensors were initially developed at LLL for pulse-energy measurement on exploding wires. Later the Defense Nuclear Agency sponsored the present project to develop the magnetic thin film devices as EMP diagnostic tools. The Air Force Weapons Lab supported the work to test the field capabilities of the thin film devices at ARES test facility, Kirtland AFB. Sandia Lab is now using a new version of the thin film sensors to monitor the transient current induced by intense radiation in their hybrid microcircuits. Also, a field test has been planned with Naval Electronics Laboratory Center where the thin film sensors are to be used to measure peak CW current caused by rf radiation. Research results are summarized. (WHK)

5643 (UCRL-76590) ATTRIBUTES OF SYSTEM TESTING WHICH PROMOTE COST-EFFECTIVENESS. Martin, L. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Oct 1975. Contract W-7405-Eng-48. 12p. (CONF-750988-1). Dep. NTIS $4.50.

From DNA EMP seminar on system level testing; Menlo Park, California, USA (9 Sep 1975).

A brief overview of conventional EMP testing activity examines attributes of overall systems tests which promote cost-effectiveness. The general framework represents an EMP-oriented systems test as a portion of a planned program to design, produce, and field system elements. As such, all so-called system tests should play appropriate cost-effective roles in this program, and the objective here is to disclose such roles. The intrinsic worth of such tests depends not only upon placing proper values on the outcomes, but also upon the possible eventual consequences of not doing tests. A relative worth measure is required. Attributes of EMP system testing over the range of potential activity which encompasses research and development, production, field handling, verification, evaluation, and others are reviewed and examined. Thus, the relative worth, in a cost-effective sense, is provided by relating such attributes to the overall program objectives so that values can be placed on the outcomes for tradeoff purposes. (auth)

Miscellaneous Instruments

Refer also to abstracts 5451, 5507, 5520, 5947, 5995, and 6271.

5644 (DHEW/FDA-76-8013) COMPARISON OF INSTRUMENT PERFORMANCE IN MEASURING X-RAY TUBE CURRENT AND mAs. Daniels, C. J. III; Silberberg, J. L. (Bureau of Radiological Health, Rockville, Md. (USA). Div. of Electronic Products). Aug 1975. 33p. Bureau of Radiological Health, Rockville, MD.

The Bureau of Radiological Health has evaluated two commercially available, noninvasive, large-aperture current probe systems for suitability in the measurement of x-ray tube current and x-ray tube current-time product as required in the enforcement of the Federal performance standard for diagnostic x-ray equipment. The response of the two systems to typical x-ray tube current waveforms is investigated and compared to the response necessary for good accuracy over the range of expected exposure times and tube currents. (auth)

5645 (HMI-B-176) CAMAC INTERFACE FOR PARALLEL TRANSFER OF DATA AND CONTROL OF MULTICHANNEL ANALYZER. Becker, H.; Lengauer, C. (Hahn-Meitner-Institut

fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Datenverarbeitung und Elektronik). Jul 1975. 33p. (In German). Dep. NTIS (US Sales Only) $5.00.

A data link between Nuclear Data System Analyzers Type 2200/2201 and a computer by means of a CAMAC interface, manufactured by Packard Instrument Company, are described. The Multichannel Analyzer (MCA)-Interface is commercially available and requires only simple modifications for interfacing various analyzers. The specifications of the CAMAC-Interface are discussed, and the signals for control of the Nuclear Data System Analyzers 2200/2201 are described. The computer controls all Multichannel Analyzer functions, and the corresponding timing-signals are explained. Furthermore the functions of the essential front-panel controls of the Master Control- and Read-IN/OUT Display units are given. The tabular presentation of the control signals of the System Analyzer and the CAMAC interface shows the required modifications at the Interface. Also the special cables for interconnections are described. The command structure of the CAMAC interface is explained, and finally a program example for a fully automatic measuring sequence including data storage with a PDP 11/20 computer is given. (auth)

5646 (ORNL-tr-2924) SMORN-1: THERMOELECTRICALLY GENERATED NOISE IN SHEATHED THERMOCOUPLES AND IN OTHER LOW LEVEL INSTRUMENTATION CABLES. Mathieu, F.; Meier, R.; Soenen, M.; Delcon, M.; Nysten, C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1974. Translated by M. Gerrard, H. H. Hubbell, and R. L. Shepard from a French report. (CONF-741065-4). 49p. Dep. NTIS $5.00.

From EACRP specialist meeting on reactor noise from critical facilities to power plants; Rome, Italy (21 Oct 1974).

Starting from the fact that thermoelectric emfs of thermocouples are generated in the thermal gradients and not at the hot junction, it is shown how thermoelectric heterogeneity in conjunction with natural and forced convection phenomena gives rise to unwanted noise called: "thermoelectric noise" in the technological sense. A distinction is made between four different types of noise–i.e. uncorrelated noise, correlated noise, spectral noise and thermoelectric noise in the physical sense–each of which has its own characteristics. The experimental results presented reveal that noise amplitudes may be quite embarrassing when dealing with problems of quantitative signal fluctuation analysis. It is however emphasized that thermoelectric noise may also convey useful information which, without noise, might be lost. (auth)

5647 (UCRL-77446) MASS SPECTROMETER DATA SYSTEM AT LLL. Friesen, R. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1975. 4p. (CONF-751128-1). Dep. NTIS $4.50.

From plutonium sample exchange meeting; Miamisburg, Ohio, USA (18 Nov 1975).

The data systems on the three mass spectrometers at LLL are computer-controlled, pulse-counting systems synchronized to a repeatedly-swept magnetic field. The data are accumulated in the memory of the computer or in a Nuclear Data ND 180 in a multiscaler mode of operation. This mode of sweeping allows a continuous check of the background stability and makes tune-up easier. But the main benefit is a reduction in the required ion emission rate stability. By the use of standards to set the system dead time, we have been able to utilize the sensitivity of a pulse counting system without the expense of exotic equipment. (auth)

5648 METHOD OF MEASURING THE MAGNETIC SPECTRA OF REACTOR-IRRADIATED FERRITES. Dem'yanov, V. V.; Podsekin, A. K. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 632-633(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 240-241(1975).

A description is given of a set of equipment for rapid measurement of the frequency dependence of the magnetic susceptibility (magnetic spectra) over the range 10^2 to 10^{10} Hz for reactor-irradiated ferrites. The above requirements are met while eliminating some additional errors due to specimen variation and neutron-flux fluctuations while making all measurements on one specimen with a single coaxial holder. (WHK)

5649 TWO-CHANNEL SPECTROMETER FOR NUCLEAR SPIN ECHOE. Biryukov, I. P.; Shumilov, Yu. P. (Irkutsk State Univ., USSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 4, 51-54(1975). (In Russian).

A spectrometer is described enabling to investigate several nuclear spin systems by nuclear resonance frequencies. The block diagram and the circuit diagram of the equipment are reviewed. The basic parameters of the spectrometer are presented. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 4979 and 5422.

5650 (FRNC-CONF-124) EURODIF PROGRAM: PRESENT STATUS OF THE PROJECT. Besse, G. (Paris-11 Univ., 91 - Orsay (France)). 1975. 9p. (CONF-750324-8). Dep. NTIS (US Sales Only) $4.50.

From international conference on uranium isotope separation; London, UK (5 Mar 1975).

History of the Eurodif project, benefits offered by gaseous diffusion, realization of the Eurodif project, and Eurodif's marketing policy are discussed. (LK)

5651 APPARATUS FOR CONCENTRATING BY DUAL TEMPERATURE EXCHANGE. Spevack, J. S. (to Deuterium Corp.). US Patent 3,907,509. 23 Sep 1975. Filed date 11 Mar 1968. 12p.

The dual temperature exchange apparatus, with a dual temperature stage having a hot processing tower and a cold processing tower, is provided with means for transferring heat from the hot processed gas to both liquid and gas being delivered to the hot processing tower. The heat exchange system provides means for effecting direct contact between the hot processed gas and the cold processed liquid being delivered to the hot tower, means for establishing a circulation of the resulting heated processed liquid, and means including an indirect contact exchanger for transferring heat from said circulation to condition the gas being supplied to the hot processing tower. The reactants in the example given are hydrogen sulfide gas and liquid water. (auth)

5652 DIELECTROPHORETIC SEPARATION OF GASEOUS ISOTOPES. McConnell, D. B. US Patent 3,907,521. 23 Sep 1975. Priority date 30 Nov 1973, Canada. 6p.

Gaseous isotopes are separated from a mixture in a vertically elongated chamber by subjecting the mixture to a nonuniform transverse electric field. Dielectrophoretic separation of the isotopes is effected, producing a transverse temperature gradient in the chamber, thereby enhancing the separation by convective countercurrent flow. In the example given, the process and apparatus are applied to the production of heavy water from steam. (auth)

5653 APPARATUS FOR CONCENTRATING BY DUAL TEMPERATURE EXCHANGE. Spevack, J. S. (to Deuterium Corp.). US Patent 3,907,508. 23 Sep 1975. Filed date 6 Feb 1969. 18p.

Improvements in an apparatus for isotope concentration by dual temperature exchange between feed and auxiliary fluids in a multistage system are described. The first fluid is a vaporizable liquid and the auxiliary fluid a gas, the apparatus having means for cascading the auxiliary fluid and the feed fluid in vapor and preferably also in liquid form. The apparatus also contains new combinations of means for improving the heating and/or cooling and/or humidifying and/or dehumidifying operations of the system. The reactants in the example given are hydrogen sulfide gas and liquid water. (auth)

5654 SYSTEM FOR ENRICHMENT BY DUAL TEMPERATURE EXCHANGE. Spevack, J. S. (to Deuterium Corp.). US Patent 3,907,500. 23 Sep 1975. Filed date 26 Sep 1966. 12p.

In dual temperature isotope exchange systems utilizing different fluid substances in liquid and gas phases separable from and soluble in each other (for example H_2O and H_2S), the phases are passed countercurrent to each other in towers maintained at relatively hot and cold temperatures. Combinations of method and means are provided by which the gas is raised to hot tower temperature and humidity conditions principally by heat derived from the cooling and dehumidification of the gas leaving the hot tower as it is being reduced in temperature and humidity to cold tower conditions. Special provisions are made in the combinations for transferring this heat and for completing the conditioning of the gas to the respective tower conditions with high efficiency, for economically controlling the temperature of the condensate to adapt it for transfer to different parts of the system, and for economically stripping dissolved gas and heat from the effluent liquid and returning it to the system in manners that aid the thermal conditioning of the main gas stream. (auth)

5655 INTERACTION BETWEEN ENRICHMENT PLANT OPERATING PHILOSOPHY AND OTHER SEGMENTS OF THE NUCLEAR FUEL CYCLE. Macnabb, W. V. (NUS Corp., Rockville, MD). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 37-39(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5656 URANIUM ENRICHMENT SUPPLY/DEMAND CONSIDERATIONS AND TECHNOLOGY CHOICES. Browne, H. L. (Bechtel Corp., San Francisco). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 47-48(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Isotopic Power Sources

Refer also to abstracts 5400 and 5934.

5657 (BNWL-1845-15) PACIFIC NORTHWEST LABORATORY MONTHLY REPORT TO ADVANCED NUCLEAR ENERGY SYSTEMS, SPACE AND SPECIAL PURPOSES DIVISION FOR AUGUST 1975. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 7p. Dep. NTIS $4.00.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term SrF_2 compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

5658 (DP-MS-75-63) FABRICATION OF GRANULE AND PELLET HEAT SOURCES FROM OXALATE-BASED $^{238}PuO_2$. Bickford, D. F.; Rankin, D. T. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 38p. (CONF-751038-2). Dep. NTIS $5.00.

From American Ceramic Society; Seattle, Washington, USA (29 Oct 1975).

Suitable fuel forms for radioisotopic thermoelectric generators are granules of high internal density (greater than 95 percent of theoretical) or geometric shapes (80 to 90 percent dense) such as pellets or spheres. Both forms can be made from calcined ^{238}Pu (III) oxalate. The conditions for processing PuO_2 are controlled during fuel form fabrication to ensure pellet integrity; to control density, grain size, and porosity distribution; and to minimize the fraction of potentially respirable fines. The competing phenomena of expansion caused by radiation damage (including helium generation from radioactive decay of plutonium) and shrinkage caused by sintering must be controlled to assure dimensional stability. The variation of microstructure and related physical properties with process parameters is discussed. (auth)

5659 (DPST-75-128-8) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Aug 1975. Contract AT(07-2)-1. 42p. Dep. NTIS $5.00.

Progress during August 1975 in the development of $^{238}PuO_2$ heat sources is reported. In studies to characterize $^{238}PuO_2$, the following were concluded: particle size was determined to be the most important characteristic affecting the variation in fabricability of $^{238}PuO_2$; problem feed consists of smaller particles (2 to 4 mum) than older, acceptable feed (4 to 6 mum). The particle size of new feed has varied from 3 to 10 mum primarily as a result of varying precipitation temperature; equations have been developed from statistically designed precipitation experiments that relate precipitation temperature, nitric acid concentration, and plutonium concentration to particle size; characteristics of acceptable feed have been defined: a particle size mode of 4.5 to 6.0 mum, with an agglomeration index of 20 to 50 wt percent, and 0 to 15 wt percent of fines (less than 2 mu m particles); precipitation temperature is the most important variable affecting particle size; and desired particle characteristics can be achieved by precipitating at 35 +- 5°C, 1.2 +- 0.1M nitric acid, and 4 to 7 g/l plutonium in the feed solution. No deleterious effects from ultrasonic decontamination were observed on either fuel form simulants or the iridium containment shells. Helium release studies show that shards can be stored for over a year without

producing microstructural damage in hot-pressed products. Temperature gradients of only 50°C during shard seasoning can affect product quality. Presintering of cold-pressed pellets before breakup produces shards for the Milliwatt Radioisotopic Thermoelectric Generator Program (Milliwatt) with a minimum of fines. Fines content of these shards compares favorably with the fines associated with the Mound Laboratory hydroxide shards. (auth)

5660 (DPST-75-128-9) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Sep 1975. Contract AT(07-2)-1. 27p. Dep. NTIS $5.00.

Progress during Sept. 1975 in the development of $^{238}PuO_2$ heat sources is reported. Characterization of Los Alamos Scientific Laboratory (LASL) samples confirms that small mode size and high tap density of as-received powder are indicative of poor fabricability. Helium bubble formation at grain boundaries of shards aged 20 months did not affect fracture behavior at room temperature. Ultrasonic decontamination of iridium-clad spheres with detergent and nitric acid gave results comparable to the Mound Laboratory procedure of soaking in concentrated HNO_3-HF solutions. Design of the Plutonium Experimental Facility is 90 percent complete. (auth)

5661 (MLM-2213) DESIGN, TESTING, AND FABRICATION OF HEAT SOURCES FOR UNDERWATER APPLICATION. Luthy, D. F.; Anderson, C. G. (Mound Lab., Miamisburg, Ohio (USA)). 5 Nov 1975. Contract E-33-1-GEN-53. 13p. Dep. NTIS $4.00.

The sequence of events in the design, testing and fabrication of a radioisotopic heat source using available $^{238}PuO_2$ fuel that would be amenable to a Navy 0.5-W (electrical) Radioisotopic Thermoelectric Generator for undersea application is discussed. Various designs were considered as a function of heat leak in order to adopt the most desirable capsule for a volume-constrained application. Testing considerations are discussed for capsule compliance with IAEA/ENEA Safety Series 6 and 33 and 10 CFR 71. (auth)

5662 TENTH INTERSOCIETY ENERGY CONVERSION ENGINEERING CONFERENCE, NEWARK, DELAWARE, AUGUST 18--22, 1975. New York; Institute of Electrical and Electronics Engineers, Inc. (1975). 1572p. (CONF-750812--). $50.00.

The 227 papers presented at the conference cover solar buildings, solar heating and cooling, solar thermal electric generation, solar utilization, space solar systems, LMFBR, energy storage and components, automotive engines, fuel cells, urban systems, nuclear power systems, thermionic energy conversion; photovoltaic conversion lithium batteries, topping cycles, unique engines, molten salt/solid electrolyte batteries, synthetic liquid fuels from coal and oil shale, energy conservation, thermoelectric systems, aqueous batteries, alternative fuels, isotopic power systems, Stirling cycle engines, wind systems, Brayton cycle systems, hydrogen, biomedical power, Rankine cycle systems, wind system applications, and heat pipe applications. The papers were processed individually for NSA and the ERDA energy data base. (LK)

For abstracts of individual papers see: 5363, 5364, 5400, 5422, 5663–5680, 6672–6674, 6691, 6746–6753, 6773, and 6800.

5663 SUBLIMATION BEHAVIOR OF SILICON NITRIDE (Si_3N_4) COATED SILICON GERMANIUM (SiGe) UNICOUPLES. Stapfer, G.; Truscello, V. C. (Jet Populsion Lab., Pasadena, CA). pp 730-735 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th Intersociety Energy Conversion Engineering Conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

For the Multi-Hundred Watt (MHW) Radioisotope Thermoelectric Generator (RTG), the silicon germanium unicouples are coated with silicon nitride to minimize degradation mechanisms which are directly attributable to material sublimation effects. A program has been underway at JPL to determine the effective vapor suppression of this coating as a function of temperature and gas environment. The results of weight loss experiments, using Si_3N_4 coated hot shoes (SiMo), operating over a temperature range from 900°C to 1200°C, are analyzed and discussed. These experiments were conducted both in high vacuum as well as at different pressures of carbon monoxide (CO) to determine its effect on the coating. Although the results show a favorable vapor suppression at all operating temperatures, the pressure of the CO and the thickness of the coating have a decided effect on the useful lifetime of the coating. (auth)

5664 SNAP 19 PIONEER AND 11 RTG DEEP SPACE PERFORMANCE. Goebel, C. J. (Teledyne Energy Systems, Timonium, MD). pp 868-872 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

Power to conduct experiments and to return the data back to Earth from distances up to and possibly exceeding 1.5 billion miles is furnished to the Pioneer 10 and 11 deep space probes by four SNAP 19 type thermoelectric generators each. The plutonium-fueled power systems produced a nominal 160 watts after launch at a generator conversion efficiency of 6.2 percent. Following five years of flight between the spacecrafts, the primary objectives, successful flyby of Jupiter, have been achieved, and Pioneer 11 was targeted for Saturn. Power system performances have been satisfactory and consistent with predictions which conclude that sufficient power will be available to conduct Saturn experiments in 1979. (auth)

5665 PERFORMANCE TESTING OF THERMOELECTRIC GENERATORS AT JPL. Rouklove, P.; Truscello, V. C. (Jet Propulsion Lab., Pasadena, CA). pp 873-879 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

Several thermoelectric generators, ranging in output power from 170 watts to microwatts, are undergoing testing at JPL. They represent a wide range of technologies using advanced PbTe, SiGe and cascaded PbTe and BiTe thermoelectric materials. Several of these generators are of an advanced concept while others are representative of the Nimbus, Transit, Viking and the Multi-Hundred Watt (MHW) technology. Of interest is the behavior of generators which have been tested for times in excess of 60,000 hours. (auth)

5666 MHW CONVERTER (RTG). Kelly, C. E. (General Electric Co., Philadelphia). pp 880-886 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The MHW Converter is a ^{238}Pu-fueled power supply being developed by ERDA to provide 150-W units for space applications. Silicon-germanium thermoelectric materials are used to convert the heat from the isotope to electrical power at a design voltage of 30 volts. The initial converter performance and the degradation mechanisms which affect long-term performance are discussed. (auth)

5667 THERMOSTRUCTURAL ANALYSIS OF THE MHW-RTG GRAPHITE AEROSHELL. Stadter, J. T.; Weiss, R. O. (Johns Hopkins Univ., Laurel, MD). pp 887-893 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The requirements for performance and safety form the basis for the design of nuclear fueled thermoelectric generators in spacecraft applications. Nearterm missions will rely on the MHW system to provide electrical power. Should a post launch failure result in atmospheric reentry, the heat source will be protected by an outer cylindrical graphite heat shield. Among the possible reentry modes, the most critical one for the heat shield structure is prompt reentry. There are many aspects of a complete reentry analysis. Only one of them associated with thermostructural design evaluation is considered here. A general plane-section stress analysis has been developed and incorporated in an existing finite element computer program. The new plane analysis is referred to as the "stress-resultant" condition. Results are given for a particular side-stable reentry condition which are compared with two conventional plane analyses. The importance of the proper plane-section analysis is illustrated by comparing maximum equivalent stress against the statistical variation of ultimate strength data for the heat shield graphite material. (auth)

5668 NUCLEAR HEAT SOURCE FOR CRYOGENIC REFRIGERATORS IN SPACE. Raab, B.; Schock, A.; King, W. G. (Fairchild Space and Electronics Co., Germantown, MD). pp 894-900 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

To supply the heat input required by space-borne cryogenic refrigerators, a possible design for a reliable ^{238}Pu radioisotope heat source, based on state-of-the-art technology, is described. The isotope heat source, which makes use of existing fuel elements, would replace electrical heaters powered by solar panels

and batteries, without requiring redesign of the refrigerators. The heat source contains all necessary safety features, and also a simple thermal control system to permit refrigerator shut-down for indefinite duration. A system for thermal interfacing with the spacecraft, the booster, and ground support is also described. The isotope heaters are compared with solar-electric heaters for the same application, and found to result in very significant weight and size savings. (auth)

5669 DEVELOPMENT OF A HEAT SOURCE ASSEMBLY FOR AN ISOTOPE BRAYTON SPACE POWER CONVERSION SYSTEM. Wein, D. (General Electric Co., Philadelphia). pp 901-910 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The promise of high efficiency and reliability for the Brayton power conversion system has fostered development of an Isotope Brayton System by NASA and the AEC (ERDA). Component hardware for ground demonstration and endurance tests are presently under contract. The work being accomplished on one of these components, the Heat Source Assembly (HSA), is summarized. This unit, designed to accommodate the Multi-Hundred Watt Isotope Heat Source, requires the verification of advanced technologies associated with fabrication of a refractory alloy heat exchanger and the operation of a unique emergency cooling system to preclude a radiological hazard from the isotope fuel in the event of a system failure in space. The heat exchanger is a hot gas pressure bonded columbium (niobium) alloy machined plate fin core assembly that is welded to inlet and outlet header scrolls. This assembly must be capable of sustained, leak proof operation at 1800°F in space vacuum for 10 years, after being subjected to cyclic temperatures and pressures during ground tests. Emergency cooling of the plutonium oxide-fueled heat source is required in space if a failure occurs which could cause an overtemperature of the isotope fuel containment. Emergency cooling is effected by melting of the thermal insulation blanket which during normal operation of the Brayton system must limit heat loss from the HSA. Design of the insulation blanket to meet these requirements with materials that are operationally stable and compatible with the refractory materials in the system, is a challenging development. (auth)

5670 ADVANCED HEAT SOURCE DEVELOPMENT FOR STATIC AND DYNAMIC RADIOISOTOPE SPACE POWER SYSTEMS. Schumann, F. A.; Osmeyer, W. E. (Teledyne Energy Systems, Timonium, MD). pp 911-915 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

An advanced radioisotope heat source development for spacecraft power systems using thermoelectric generators or Brayton, Rankine, or Stirling power cycles is described. In the past, the majority of heat sources developed and launched have been comprised of one or two capsules containing the total fuel inventory in a single reentry heat shield. The new technology in heat source development is directed toward modularization with numerous small capsulettes and reentry heat shield modules. The significant advantages of this concept include total heat source design optimization permitting maximum flexibility in design scaleability and safety margins substantially greater than heretofore demonstrated. The heat source design approach is based upon low weight high aerodynamic drag rectangular heat shields fabricated from a 3D carbon/graphite composite and each containing a number of small capsulettes containing pressed and sintered pellets of pure plutonium oxide (PPO). The small heat source modules are readily stacked in a configuration optimal for the static or dynamic cycle power system mission power requirement. Heat source modules are presently on test for an extended period of time to demonstrate material compatibility and helium venting performance. The capsulettes are fabricated from Pt-3008, an alloy developed by Oak Ridge National Laboratory for encapsulation of ^{238}Pu. (auth)

5671 EFFICIENT THERMO-MECHANICAL GENERATION OF ELECTRICITY FROM THE HEAT OF RADIOISOTOPES. Cooke-Yarborough, E. H.; Yeats, F. W. (United Kingdon Atomic Energy Authority, Harwell, Eng.). pp 1003-1011 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The thermomechanical generator uses a thermomechanical oscillator to convert heat efficiently into a mechanical oscillation which in turn excites a suitable transducer to generate alternating electricity. The thermomechanical oscillator used is based on the Stirling cycle, but avoids the need for rotary motion and for sliding pistons by having a mechanically-resonant, spring-suspended displacer, and by using an oscillating metal diaphragm to provide the mechanical output. The diaphragm drives an alternator consisting of a spring-suspended permanent magnet oscillating between fixed pole pieces which carry the electrical power output windings. Because a thermomechanical generator is much more efficient than a thermo-electric generator at comparable temperatures, it is particularly suitable for use with a radioisotope heat source. The amounts of radioisotope and of shielding required are both greatly reduced. A machine heated by radioisotopes and delivering 10.7W ac at 80Hz began operating in October, 1974. Operating experience with this machine is reported, and these results, together with those obtained with higher-powered machines heated by other means, are used to calculate characteristics and performance of thermo-mechanical radioisotope generators capable of using heat sources such as the waste-management ^{90}Sr radioisotope sources becoming available from the US nuclear waste management programme. A design to use one of these heat sources in a 52-W underwater generator is described. (auth)

5672 CARDIAC PACEMAKER POWER SOURCES. Gasper, K. A.; Fester, K. E. (Medtronic, Inc., Minneapolis). pp 1205-1213 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From tenth intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A review of chemical and radioisotope batteries used in cardiac pacemakers is presented. The battery systems are examined in terms of longevity, reliability, cost, size and shape, energy density, weight, internal resistance versus time, end-of-life voltage, chemical compatibility, and potential failure mechanisms. (TFD)

5673 DEVELOPMENT OF POWER SOURCES FOR BLOOD PUMP APPLICATIONS. Von Reth, R. D. (MBB GmbH, Munich); Haerten, R.; Nemsmann, U.; Henning, E.; Buecherl, E. S. pp 1214-1222 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From tenth intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

During early development efforts in the field of cardiac assist and replacement systems (KUE) it became evident, that the growing number of technological problems cannot be solved by a single university research team. Hence, an interdisciplinary project team was established as suggested by the Federal Ministry of Research and Technology (BMFT). The joint efforts of a medical-technical team are described. The extent of animal testing is summarized. Emphasis is placed on the development status of two implantable power sources, a thermal converter and an electro-hydraulic converter. (RCK)

5674 ARTIFICIAL HEART SYSTEM THERMAL CONVERTER AND BLOOD PUMP COMPONENT RESEARCH AND DEVELOPMENT. Pouchot, W. D.; Bifano, N. J.; Hanson, J. P. pp 1223-1231 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812--.

A bench model version of a nuclear-powered artificial heart system to be used as a replacement for the natural heart was constructed and tested as a part of a broader U. S. ERDA program. The objective of the broader program has been to develop a prototype of a fully implantable nuclear-powered total artificial heart system powered by the thermal energy of plutonium-238 and having minimum weight and volume and a minimum life of ten years. As a forward step in this broader program, component research and development has been carried out directed towards a fully implantable and advanced version of the bench model (IVBM). Some of the results of the component research and development effort on a Stirling engine, blood pump drive mechanisms, and coupling mechanisms are presented. The Stirling-mechanical system under development is shown. There are three major subassemblies: the thermal converter, the coupling mechanism, and the blood pump drive mechanism. The thermal converter uses a Stirling cycle to convert the heat of the plutonium-238 fueled heat source to a rotary shaft power output. The coupling mechanism changes the orientation of the output shaft by 90 degrees and transmits the pumping power by wire-wound core flexible shafting to the pumping mechanism. The coupling mechanism also provides routing of the coolant lines which carry the cycle waste heat from the thermal converter to the blood pump. The change in orientation of the thermal converter output shaft is for convenience in implanting in a calf. This orientation of thermal converter to blood pump seemed to give the best overall

system fit in a calf based on fit trials with wooden models in a calf cadaver. (RCK)

5675 ANNULAR TIDAL REGENERATOR ENGINE FOR NUCLEAR CIRCULATORY SUPPORT SYSTEMS. Hagen, K. G.; Ruggles, A. E.; Fam, S. S.; Torti, V. A. (Thermo Electron Corp. Research and Development Center, Waltham, MA). pp 1232-1241 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

In order to simplify the configuration of the tidal regenerator engine nuclear-powered circulatory support system, thereby drastically reducing its size and improving the intrinsic reliability, the engine has been redesigned. This redesign focuses on allowing power to be extracted at the low temperature end of the engine utilizing a piston-cylinder arrangement wherein all of the necessary heat transfer processes occur in the annular gap between the piston and cylinder. In all other respects the engine retains its basic characteristics as a hybrid between a Stirling engine and a Rankine engine. A significant advantage of the new arrangement is the ability to raise the superheat temperature limit from 650°F to over 900°F. This has yielded an increase in engine efficiency from 10 percent to 14 percent, and further increases are anticipated by utilizing an expansion and/or a binary version of the engine. The implantable system volume has been reduced by a factor of three and orientation insensitivity with respect to gravity has been demonstrated. Many system components have already demonstrated endurances of several thousand hours. (auth)

5676 THERMOCOMPRESSOR POWERED ARTIFICIAL HEART ASSIST SYSTEM. Moise, J. C.; Rudnicki, M. I.; Faeser, R. J. pp 1242-1245 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The development of a fully implantable, left ventricular assist system is described. The system utilizes a radioisotope-powered Stirling cycle thermocompressor and an all-pneumatic actuation and control system to drive a pusher-plate type blood pump. This basic approach has been shown to be efficient and workable by implantation experiments on calves. The recent effort has been directed toward the fabrication and development of a fourth-generation system, designed to reduce weight, volume and isotope inventory. Extensive endurance and accelerated-life testing has been undertaken. The improved design concepts utilized in the system and pertinent test results are discussed. (auth)

5677 STIRLING ENGINE WITH HYDRAULIC POWER OUTPUT FOR POWERING ARTIFICIAL HEARTS. Johnston, R. P.; Noble, J. E.; Emigh, S. G.; White, M. A.; Griffith, W. R.; Perrone, R. E. (McDonnell Douglas Astronautics Co., Richland, WA). pp 1448-1455 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The DWDL heart power source combines the high efficiency of Stirling engines with the reliability, efficiency, and flexibility of hydraulic power transfer and control to ensure long system life and physiological effectiveness. Extended life testing has already been achieved with an engine module; animal in-vivo tests with an assist heart have consistently demonstrated required performance by biological synchronization and effective ventricle relief. The present System 5 can reliably meet near-term thousand-hour animal in-vivo test goals as far as the durability and efficacy of the power source are concerned. Carefully planned development of System 6 has produced major reductions in size and required input power. Research engine tests have provided the basis for achieving performance goals and the approach for further improvement is well established. The near term goal is 33 W heat input with 16 W input projected for normal physical activity. The goal of reduction of engine module volume to 0.9 liter has been achieved. Demonstrated reliability of 292 d for the engine and 35 d for the full system, as well as effectiveness of the artificial heart power source in short-term in-vivo tests indicate that life-limiting problems are now blood pump reliability and the machine-animal interface. (auth)

5678 COMPONENT DEVELOPMENT OF "TORES" FOR ARTIFICIAL HEART DEVICE. Boretz, J. E. (TRW Systems, Redondo Beach, CA); Lurie, H.; Wright, H.; Nagyszalanczy, L.; Silver, A. pp 1456-1465 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The Turbine Organic Rankine Engine System (TORES) consists of a hybrid heat engine capable of generating both hydraulic and electric power. The hydraulic power is used to drive the actuator of a prototype H-TAH blood pump and is generated by a centrifugal pump driven by a radial-inflow, Banki-type turbine using an organic Rankine cycle operating mode. Electric power, required only to operate the valves and controls of the hydraulic control system, is generated by a small, static, thermoelectric generator (TEG). The component test results are described for the breadboard version of the TORES. This development effort is a continuation of the Phase I program conducted under the sponsorship of the Cardiovascular Devices Branch of the National Heart and Lung Institute. In general, the performance levels achieved by the TORES components (i.e., turbine, pump, bearings, exchangers, hydraulic controls) were sufficiently high to more than meet the Phase I development goal of providing a minimum of 4 watts of hydraulic output to the H-TAH blood pump when utilizing a simulated 50 watt thermal heat source. The test results not only confirmed the adequacy of the performance of the TORES, but also provided the data needed for further optimization and miniaturization of the future integrated implantable prototype version to be implemented during Phase II of this program. (auth)

5679 PLUTONIUM-238 AS A HEAT SOURCE FOR THE ARTIFICIAL HEART. Andquist, G. M.; Smith, L. M.; Kolff, W. J. (Univ. of Utah, Salt Lake City). Contract E(11-1)-2155. pp 1473-1480 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A total artificial heart system powered for 10 years or more by a ^{238}Pu heat source appears feasible in the near future. However, hypothetical risks and injury and apparent misunderstanding surround the application ^{238}Pu. The consequences of ^{238}Pu already released to the environment, the modes of human uptake of ^{238}Pu and biological responses, the criticality aspects of ^{238}Pu and the magnitude and effects of operational radiation exposures upon the recipient of a ^{238}Pu heat source and the recipient's personal contacts are studied. (auth)

5680 ARTIFICIAL HEART SYSTEM THERMAL INSULATION COMPONENT DEVELOPMENT. Svedberg, R. C.; Buckman, R. W. Jr. (Westinghouse Astronuclear Lab., Pittsburgh). pp 1489-1495 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A concentric cup vacuum multifoil insulation system has been selected by virtue of its size, weight, and thermal performance to insulate the hot radioisotope portion of the thermal converter of an artificial implantable heart system. A factor of 2 improvement in thermal performance, based on the heat loss per number of foil layers (minimum system weight and volume) has been realized over conventional spiral wrapped multifoil vacuum insulation. This improvement is the result of the concentric cup construction to maintain a uniform interfoil spacing and the elimination of corner heat losses. Based on external insulation system dimensions (surface area in contact with host body), heat losses of 0.019 W/cm^2 at 1140°K (1600°F) and 0.006 W/cm^2 at 920°K (1200°F) have been achieved. Factors which influence thermal performance of the nickel foil concentric cup insulation system include the number of cups, configuration and method of application of zirconia (ZrO_2) spacer material, system pressure, emittance of the cups, and operating temperature. (auth)

Radiation Sources

Refer also to abstract 5539.

5681 (DP-MS-75-80) SURVEY OF POTENTIAL MARKETS FOR DEVICES USING CALIFORNIUM-252. Permar, P. H. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 14p. (CONF-751114-1). Dep. NTIS $4.00.

From Californium-252 utilization meeting; San Diego, California, USA (4 Nov 1975).

Potential applications for devices or systems containing ^{252}Cf in the years from 1975 to 1980 are estimated. The estimated number of devices and associated business value were derived from a survey of 46 industrial, educational and governmental organizations conducted from Jan. to May, 1975. Applications for

devices and systems based on ^{252}Cf are expected to increase by a factor of 7 in the 6-y period from 1975 to 1980. The annual business value of ^{252}Cf devices should increase from $1.5 million in 1975 to $10.8 million in 1980. The potential European market should be several times as large as the US market, based on actual sales of ^{252}Cf, which have been two to four times greater in Europe than in the US. (auth)

5682 CAREER OPPORTUNITIES IN THE APPLICATIONS OF RADIATION AND RADIOISOTOPES. Morganstern, K. H. (Radiation Dynamics, Inc., Westbury, NY). Nucl. Technol.; 27: No. 1 135-139(Sep 1975).

The application of radiation and radioisotopes is finally coming into its own after a long and hesitant gestation period. Overshadowed since the inception of the "Nuclear Age" by nuclear power generation, this area nevertheless provides real and challenging opportunities involving many different technical specialties and professional skills. Career opportunities are becoming available in those areas involving the use of radioactive isotopes in research, medicine, and industrial process control, and the employment of large radiation outputs, from either accelerator or isotopes, for industrial process applications. (auth)

5683 INSTRUCTIONAL PROGRESS IN THE APPLICATION OF RADIATION AND RADIOISOTOPES AT TEXAS A AND M UNIVERSITY. Smathers, J. B.; Cochran, R. G. (Texas A and M Univ., College Station). Nucl. Technol.; 27: No. 1, 131-134(Sep 1975).

The engineer as a professional is sensitive both to the needs and to the opportunities society presents. In this context, the industrial needs and opportunities presented in the nonpower utilization of radiation and radioisotopes in the State of Texas have influenced the design of the educational programs at Texas A and M University in the nonpower applications of nuclear energy. The program, as presently constituted, is a fundamental analysis of radiation detection, nuclear instrumentation, detection systems design, shielding, radiation safety, and dosimetry. This general program has met the needs of industry to date and it is anticipated that it will continue to do so for the foreseeable future. (auth)

Industrial Uses

Refer also to abstract 5562.

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstract 5704.

5684 (ERDA-tr-51, pp 1-5) DETERMINATION OF THE MOLECULAR WEIGHT OF SINGLE-STRANDED DNA CONSTITUENTS OF IRRADIATED AND NONIRRADIATED DEOXYRIBONUCLEOPROTEIN COMPLEXES. Ryabchenko, N. I.; Golubeva, R. V.; Ivannik, B. P. (Academy of Medical Sciences, Obninsk, USSR). 1975. Translated from Radiobiologiya; 15: No. 2, 171-174(1975).

In Radiobiology.

During the passage of deoxyribonucleoprotein into a solvent containing 0.01 M EDTA + 0.1 M NaOH + 0.9 M NaCl there is a dissociation of the complex and a separation of the strands of DNA. The specific viscosity of the mixture of DNA and protein obtained is determined by molecules of single-stranded DNA, which permits a determination of the intrinsic viscosity of single-stranded DNA without conducting the deproteinization of DNA. A formula relating the intrinsic viscosity of single-stranded DNA in 0.1 M NaOH + 0.9 M NaCl + 0.01 M EDTA to its molecular weight is cited. (tr-auth)

5685 (ERDA-tr-51, pp 6-12) APPEARANCE OF DEFECTS OF THE PRIMARY STRUCTURE OF X-IRRADIATED DNA IN VITRO IN KINETIC EXPERIMENTS. Fonarev, A. B.; Shugalii, A. V.; Todorov, I. N.; Paskevich, I. F. (Academy of Sciences, Ukrainian SSR, Kiev). 1975. Translated from Radiobiologiya; 15: No. 2, 175-180(1975).

In Radiobiology.

In the x irradiation of 0.025 percent solutions of DNA, isolated from the calf thymus, the nature of the distribution of defects of the primary and secondary structures, as well as the influence of these disorders on the kinetics of reassociation, was investigated. The nature of the distribution of defective sites along the chain of the macromolecule is discussed. It was shown that the kinetics of the reassociation of irradiated DNA preparations is complex, differing from the kinetics of the native preparation. It was established that at a dose of 3 kR the distribution of defects along unique and repetitive sequences is close to equiprobable. (tr-auth)

5686 (ERDA-tr-51, pp 22-25) INFLUENCE OF ULTRAVIOLET AND X RAYS ON THE CHROMOPHORE GROUPS OF PROTEINS IN SOLUTIONS. Buturlakin, M. S.; Shmelev, V. P. (Voronezh State Univ., USSR). 1975. Translated from Radiobiologiya; 15: No. 2, 189-192(1975).

In Radiobiology.

The changes in the differential absorption spectra of solutions of blood serum induced by uv and x rays and the perturbation absorption spectra of solutions of human gamma-globulin were studied. The ratio of the changes in the positions of the maxima of the perturbation absorption spectra of the tyrosine and tryptophan amino acid residues under the influence of uv rays is evidence of a relatively great vulnerability of the tyrosine amino acid residues in comparison with the tryptophan residues under the influence of x rays. It was suggested that there is an interrelationship of the absorption at the wavelength 235 nm with conformational rearrangements, caused by the influence of radiation on the protein macromolecules. (tr-auth)

5687 (ERDA-tr-51, pp 106-109) STUDY OF THE MODIFYING ACTION OF CAFFEINE ON CERTAIN BIOSYNTHETIC PROCESSES IN GAMMA-IRRADIATED PEA ROOTS. Golikova, O. P. (Academy of Sciences Ukrainian SSR, Kiev). 1975. Translated from Radiobiologiya; 15: No. 2, 269-272(1975).

In Radiobiology.

In connection with the problem of postradiation recovery of plants from ionizing radiations and the participation of repair processes in it, the modifying action of caffeine on the synthesis of DNA, RNA, and protein, as well as on growth processes in gamma-irradiated pea seedlings was studied. On the basis of the experimental material cited, it can be assumed that caffeine in nonirradiated tissues has an effect on transcription and protein synthesis, in addition to its action on the cell membrane, in view of its ability to be bound to single-stranded nucleic acids. However, in contrast to previous reports, in our experiments caffeine inhibited RNA synthesis to a greater degree than protein synthesis. The intensification of the action of radiation in irradiated roots is evidently associated with an inhibition of repair processes. (ERB)

5688 (ERDA-tr-51, pp 113-115) STIMULATION OF THE INCORPORATION OF 1-^{14}C-ACETATE INTO THE PHOSPHOLIPIDS OF ORGANELLES OF LIVER CELLS OF IRRADIATED RATS. Kolomiitseva, I. K.; Kaznacheev, Yu. S. (Academy of Sciences of the USSR, Pushchino). 1975. Translated from Radiobiologiya; 15: No. 2, 275-277(1975).

In Radiobiology.

The purpose of the work was an investigation of the incorporation of 1-^{14}C-acetate, which is an index of the turnover of the carbon skeleton of the phospholipids, into the phospholipids of the substructures of rat liver cells in the normal state and 1 hour after whole-body irradiation at a lethal dose. The results indicate that the synthesis of various parts of the phospholipid molecule occurs at different rates and corresponds unambiguously to the influence of ionizing radiation. (ERB)

5689 EFFECTS OF METAL IONS ON RADICAL FORMATION IN GAMMA-IRRADIATED DNA IN THE SOLID STATE. Rotlevi, E.; Moss, H. M.; Kominami, S.; Riesz, P. (National Cancer Inst., Bethesda, MD). Ann. N. Y. Acad. Sci.; 222: 387-410(31 Dec 1973).

The effects of metal ions on the formation of radicals produced by gamma radiolysis of DNA in vacuo were studied by esr and hydrogen-transfer measurements. At metal to nucleotide ratios of 1:10, a three- to tenfold decrease of the esr signal due to carbon was observed for transition metals such as Cr^{3+}, Fe^{3+}, Fe^{2+}, Ni^{2+}, and Co^{2+}, and smaller decreases (by 25 to 40 percent) were seen for paramagnetic rare earths (Eu^{3+}, Yb^{3+}, and Sm^{3+}). These effects were independent of dose and temperature (77 to 298^{0}K). The diamagnetic ions Mg^{2+}, Zn^{2+}, Cd^{2+}, Ag^{+}, La^{3+}, and Lu^{3+} had no effect; however, Ce^{4+}, Pb^{2+}, Sn^{4+}, and Hg^{2+} decreased the radical yield by 10 to 60 percent. At metal to nucleotide ratios of 1:100, the radical yield was decreased twofold for Cr^{3+}, Cu^{2+}, and Fe^{2+}, about 30 percent for Mn^{2+}, Ni^{2+}, and Fe^{3+} and less than 10 percent for Co^{2+}. From measurements of the power-saturation of the carbon signal for the 1:100 metal-DNA complexes, it can be inferred that the decrease of the esr signals is not due to spin-spin interactions between carbon radicals and paramagnetic ions. For the 1:10 metal-DNA complexes, spin-spin interactions may contribute to signal reduction. However, these results correlate with measurements of the radiation-induced hydrogen transfer, which can be explained by assuming a decreased radical yield; 1:10 complexes of Ni^{2+} with adenine, polyadenylic acid, dextran, poly-DL-alanine, and poly-L-glutamic acid decreased the radical yield by 60 to 70 percent, but no effect was observed for thymine and thymidine. It appears that the metal ions act by quenching excited states and/or by charge scavenging. (auth)

5690 ESR AND ENDOR STUDIES OF IRRADIATED NUCLEIC ACID CONSTITUENTS. Box, H. C.; Freund, H. G. (Roswell Park Memorial Inst., Buffalo). Ann. N. Y. Acad. Sci.; 222: 446-451(31 Dec 1973).

As repositories of genetic information the nucleic acids are the seat of mutational changes. Consequently, when the power of electron spin resonance (esr) spectroscopy for analyzing radiation effects became apparent, many investigators were quick to apply esr to the study of radiation damage in nucleic acids and their constituents. The main difficulty in most such studies is identification of the radiation-produced radicals from their esr spectra. As technology improves, the prospect of making unambiguous identifications improves. Perhaps the most important new asset in radiation damage studies has been the introduction of electron-nuclear double resonance (endor) spectroscopy. In this paper we explore the potential significance of endor and other improved techniques for the study of radiation damage in nucleic acid constituents. (auth)

5691 INDUCTION OF PYRIMIDINE DIMERS IN NUCLEAR DNA AFTER uv IRRADIATION DURING THE SYNCHRONOUS CYCLE OF SACCHAROMYCES CEREVISIAE. Chanet, R.; Waters, R.; Moustacchi, E. (Institut du Radium, Orsay, France). Int. J. Radiat. Biol.; 27: No. 5, 481-485(May 1975).

The possibility of fluctuations in the uv induction of pyrimidine dimers during the synchronous cell-cycle of Saccharomyces cerevisiae was investigated as any changes would have to be considered when discussing variations in uv-induced lethal and genetic effects. (UK)

5692 IONIC FREE RADICALS INDUCED BY IONIZING RADIATION IN ORIENTED DNA. Graslund, A.; Ehrenberg, A.; Rupprecht, A. (Stockholm Univ.). Ann. N. Y. Acad. Sci.; 222: 374-386(Dec 1973).

In this paper we will show that by using oriented DNA it is possible to obtain resolved esr spectra of the primary free

radicals. We will give an interpretation of the spectra in terms of ionic base radicals, and also discuss the reactions of these primary species at higher temperatures and speculate somewhat over a possible sequence of events that may occur in irradiated DNA. (auth)

5693 NUCLEAR COUPLING OF ^{33}S AND THE NATURE OF FREE RADICALS IN IRRADIATED CRYSTALS OF CYSTEINE HYDROCHLORIDE AND N-ACETYL METHIONINE. Hadley, J. H. Jr. (Georgia State Univ., Atlanta); Gordy, W. Proc. Natl. Acad. Sci. U.S.A.; 72: No. 9, 3486-3490(Sep 1975).

The ^{33}S hyperfine structure has been observed in the electron spin resonance of irradiated crystals of cysteine . HCl . H_2O and of N-acetyl DL-methionine. An analysis of the results shows that in both substances the free radicals that are stable at room temperature are disulfide radicals, RCH_2SS. A possible mechanism for formation of these radicals is proposed. (auth)

5694 SOME EFFECTS OF IONIZING RADIATION ON AQUEOUS SOLUTIONS OF THIAMINE. Wilska-Jeszka, J.; Krakowiak, W. (Technical Univ. Lodz, Poland). Nukleonika; 20: No. 5, 511-516(1975).

Qualitative and quantitative changes in γ-irradiated aqueous solutions of thiamine were investigated. The radiation-induced thiamine losses have been found to depend on concentration of thiamine, radiation dose and pH of the solution. Decomposition of thiamine was accompanied by an equimolar increase in the concentration of hydrogen ions. Some vitamins and aromatic amino acids have been found to inhibit the radiation-induced degradation of thiamine. (auth)

Radiation Effects on Cells

Refer also to abstract 5750.

5695 (ERDA-tr-51, pp 57-62) INVESTIGATION OF THE MECHANISM OF THE RADIOSENSITIZING ACTION OF SMALL DOSES OF IONIZING RADIATION IN A CULTURE OF HeLa CELLS. Kalendo, G. S.; Zhurbitskaya, V. A. (Academy of Medical Sciences USSR, Moscow). 1975. Translated from Radiobiologiya; 15: No. 2, 222-227(1975).

In Radiobiology.

The sensitizing effects of preliminary irradiation (2-3 min before the basic dose of 490 rad) at a dose of 10 rad on a culture of HeLa cells was investigated. It was detected that an originally total dose, separated in this way, leads to the same stimulating effect as a dose of 10 rad. The inhibiting action of the basic dose is manifested only after 1.5 to 2 hrs. The results obtained on the radiosensitizing action of preliminary irradiation at a dose of 10 rad can be explained by delay of the complex of adaptive responses. An analysis of the dose curve showed that preliminary irradiation at a dose of 10 rad causes a decrease in the repair processes. (tr-auth)

5696 (ERDA-tr-51, pp 116-119) POSTRADIATION MODIFICATION OF RADIATION DAMAGES TO SOC CELLS BY NATURAL AND SYNTHETIC PORPHYRINS. Yartsev, E. I.; Novosel'tseva, S. D.; Kirillova, G. V.; Ponomarev, G. V.; Yarshunskii, V. G.; Goryacheva, V. N. 1975. Translated from Radiobiologiya; 15: No. 2, 277-280(1975).

In Radiobiology.

The influence of various porphyrins and their metallocomplexes on the postradiation survival of a culture of SOC cells, as well as the interrelationship between the radioprotective effectiveness, chemical structure of the tested porphyrins and the presence of metals in the molecule: Cu^{2+}, Zn^{2+}, Fe^{2+}, Mn^{2+}, and Co^{2+} was studied. It was found that the introduction of a metal into the porphyrin ring leads to changes in the radioprotective properties of the compound. From the data cited it follows that the radioprotective action of the investigated compounds depends on their chemical structure. The introduction of various substituents or metals into the porphyrin ring may substantially change the biological properties of these compounds. (ERB)

5697 DISSOCIATION OF HISTONE AND DNA SYNTHESIS IN X-IRRADIATED HeLa CELLS. Bases, R.; Mendez, F. (Albert Einstein College of Medicine, New York). Exp. Cell Res.; 69: 289-294(Dec 1971).

Although histone synthesis and DNA synthesis are normally very well coordinated in HeLa cells, their histone synthesis proved relatively resistant to inhibition by ionizing radiation. During the first 24 h after 1,000 R the rate of cellular DNA synthesis progressively fell to small fractions of control values while histone synthesis with much less relative reduction. Acrylamide gel electropherograms of the acid soluble nuclear histones synthesized by irradiated HeLa cells were qualitatively normal. (auth)

5698 PROTEIN SYNTHESIS BY X-IRRADIATED BOVINE PLATELETS. Rosiek, O. Nukleonika; 20: No. 5, 505-509 (1975).

The incorporation of ^{14}C-leucine into proteins of the normal and irradiated bovine platelets was studied. 10^9 non-irradiated platelets were incorporated on average 0.580 nmoles of ^{14}C-lucine during 1 hr of incubation. Irradiation of platelets with x-rays up to 1000 rads caused only slight inhibition of leucine incorporation into platelets. After irradiation with doses ranging from 3000 to 30,000 rads the incorporation was progressively reduced from 68.58% of the control value to 25.21%. It is concluded that protein synthesizing apparatus of the bovine platelets is relatively radioresistant. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 5691 and 5761.

5699 (ERDA-tr-51, pp 52-56) STUDY OF THE LETHAL ACTION OF IONIZING RADIATION ON CHLORELLA CELLS WITH VARIOUS CONTENTS OF INTRACELLULAR CYSTEINE. Kamchatova, I. E.; Zakharov, I. A.; Korolev, V. G.; Gracheva, L. M.; Zheleznyakova, N. Yu. (Leningrad State Univ.). 1975. Translated from Radiobiologiya; 15: No. 2, 218-221(1975).

In Radiobiology.

It was shown in experiments on related strains of Chlorella vulgaris that the content of sulfhydryl groups in cells of feeder mutants exceeds the content of SH groups in the cells of the initial wild-type strain. The radiosensitivity of the mutant forms of Chlorella does not differ from the initial wild-type strain and a revertant isolated from a culture of the mutant strain. Possibly the presence of a high level of sulfhydryl groups in the cell is not the determining factor in its resistance to ionizing radiation. (tr-auth)

5700 (ERDA-tr-51, pp 63-67) POSSIBLE NATURE OF THE INCREASED RADIORESISTANCE OF BUDDING YEAST CELLS. Korogodina, Yu. V.; Nekrasova, I. V.; Petin, V. G.; Graevskii, E. Ya. (Academy of Medical Sciences USSR, Obninsk). 1975. Translated from Radiobiologiya; 15: No. 2, 228-232(1975).

In Radiobiology.

It was shown in experiments on the diploid yeast Saccharomyces ellipsoideus strain Megri 139-B, that budding cells of a 12-hour culture, distinguished by high radioresistance, contain approximately 150 percent more endogenous thiols than more radiosensitive nonbudding cells from a seven-day culture. The authors attribute the increased radioresistance of budding yeast cells to a higher content of endogenous thiols. (tr-auth)

5701 (ERDA-tr-51, pp 82-85) LHR IN ESCHERICHIA COLI B AFTER UV IRRADIATION. Simonyan, N. V. (Erevan Physical Inst.). 1975. Translated from Radiobiologiya; 15: No. 2, 247-251(1975).

In Radiobiology.

It was shown that cells of E. coli B, irradiated with uv at various doses, are capable of reproducing under conditions close to those utilized for the study of their postradiation recovery in liquid nonnutrient media (liquid holding recovery--LHR); moreover, uv irradiation stimulates this reproduction. It was concluded that a quantitative evaluation of the reproduction of the bacteria in such media is essential, as a compulsory method in the study of LHR. (tr-auth)

5702 (ERDA-tr-51, pp 124-126) PECULIARITIES OF THE MUTAGENESIS OF BACTERIOPHAGE T4Br$^+$ UNDER THE DIRECT AND INDIRECT ACTION OF GAMMA RADIATION. Yurov, S. S. (Academy of Sciences USSR, Pushchino). 1975. Translated from Radiobiologiya; 15: No. 2, 284-286(1975).

In Radiobiology.

Earlier we demonstrated the lethal and mutagenic action of radiotoxins (RT), formed in gamma irradiation of cells of E. coli B, in the case of their infection with nonirradiated bacteriophage T4B. It was found that the rII mutations of the bacteriophage formed arise chiefly according to the type of transitions. Similar results were obtained on the radiation mutagenesis of E. coli. However, the comparative contribution of the lethal and mutagenic effects remains unknown, as does the molecular mechanism of mutagenesis under the direct and indirect action of radiation. In the case of mutagenesis of bacteriophage in vitro (nonmetabolizing system), the formation of mutations is possible as a result of the direct action of radiation (direct excitation, ionization of DNA in the head of the bacteriophage) -- type I of mutagenesis; and the indirect action of radiation on account of the formation of radicals, peroxides, and radiation chemical products of the irradiated medium (similar to chemical mutagenesis) -- type II of mutagenesis. In this case the use of bacteriophage to study the mecha-

nisms of mutagenesis permits a complete delimitation of these possible pathways of formation of a mutation and the distinguishment of each of them individually. From the literature data it follows that when extracellular bacteriophage is irradiated in broth, the direct action of ionizing radiation predominates, while in the case of irradiation in buffer solution, the indirect effect is also added. (tr-auth)

5703 RADIOSTERILIZATION OF MEDICAL PREPARATIONS WITH RADIOACTIVE ISOTOPES OF IODINE. Bochkarev, V. V.; Kharlamov, V. T.; Pikaev, A. K.; Sedov, V. V.; Pavlov, E. P.; Poapova, Z. M.; Shubnyakova, L. P.; Gus'kov, A. F.; Tushov, E. G. Med. Radiol.; 20: No. 10, 17-22(Oct 1975). (In Russian)

The study of radiation chemical processes, taking place when irradiating hippuran, bilignost, bilitrast, o-, m-, p-iodine benzoic acids, labelled by I^{131} showed that the effect from γ-irradiation of these preparations, together with their sterility manifest itself in the decrease of pH solutions and a concentration of iodine organic substances, splitting of iodide-ions, and formation of a number of side products. For the suppression of undesirable radiation-chemical processes which lead to the destruction of molecules of iodine organic substances, before irradiation preparations of radical acceptors, which possess an increased ability to react with the products of radiolysis of water in comparison with dissolved substances were introduced. In connection with relatively low microbe semination of radiopharmaceutic preparations produced in the USSR, high radiosensitivity of their microflora and partial bactericidity of some preparations, the sterilization dose can be established on the level of 1,000,000 rad. (auth)

5704 EVIDENCE AGAINST DNA AS THE TARGET FOR 334 NM-INDUCED GROWTH DELAY IN ESCHERICHIA COLI. Ramabhadran, T. V.; Jagger, J. (Texas Univ., Dallas). Photochem. Photobiol.; 21: No. 4, 227-233(Apr 1975).

Growth delay was induced with near-UV (334 nm) radiation in Escherichia coli K12 bacterial strains followed by attempts at photoreactivation (PR) of this effect at 405 nm. In the uv-sensitive strain AB2480, a small PR of the observed population growth delay occurred after 334 nm irradiation at 35°C and a much larger PR after 334 nm irradiation at 5°C. Much of the population growth delay in this strain could be explained as being due to killing, and all or most of the observed PR pertained only to this killed fraction of the population. The true cell growth delay (i.e. that of surviving cells) thus appeared to be only slightly photoreactivable. This conclusion was supported by studies with a wild-type strain KW8, which showed growth delay at non-lethal doses; this growth delay showed no PR, regardless of the temperature during 334 nm irradiation. These findings indicated that photoreactivable lesions (cyclobutyl pyrimidine dimers) are not an important cause of near-uv-induced growth delay. (UK)

5705 VIRAL DNA SYNTHESIS IN CELLS INFECTED WITH ULTRAVIOLET-IRRADIATED HUMAN ADENOVIRUS TYPE 2. Mak, S.; Mak, I. (McMaster Univ., Hamilton, Ont.). Biochim. Biophys. Acta; 340: 117-129(1974).

Human KB cells infected with human adenovirus type 2 irradiated with ultraviolet light produced very few virus particles. However, the irradiated virus was still capable of a number of viral functions. These include killing of the host cells, induction of intranuclear inclusion bodies, recruitment of cells into DNA synthesis and synthesis of viral DNA. The initiation of viral DNA was delayed and the length of the delay was found to be dependent on the ultraviolet dose. Cells infected with either ultraviolet-irradiated or non-irradiated virus synthesized similar amounts of viral DNA. These results suggest that the inactivation of adenovirus type 2 by ultraviolet light is probably not at the step of viral DNA duplication. (auth)

5706 SELECTION OF ASPERGILLUS NIGER: PRODUCER OF CITRIC ACID UNDER THE INFLUENCE OF GAMMA IRRADIATION AND CHARACTERIZATION OF ACTIVE VARIANTS. Golubtsova, V. M.; Shcherbakov, E. Ya.; Smirnov, V. A. (Leningrad Research Inst. of Food Industry). Prikl. Biokhim. Mikrobiol.; 9: No. 4, 569-574(1973). (In Russian)

The strain Asp. niger NMM-331—producer of citric acid was subjected to a step-to-step selection under the influence of gamma irradiation with doses of 5 to 200 krads. At dosages of 10 to 50 krads active and stable acid-forming mutants appeared whereas at a dosage of 100 krads morphological and biochemical mutants evolved. As a result of the three-staged selection the activity of the initial strain Asp. niger NMM-331 increased by 9.5%. Active variants showed higher radioresistance than initial strains. (auth)

5707 EFFECT OF ULTRAVIOLET IRRADIATION ON MEAT MICROFLORA. Mudretsova-viss, K. A.; Zavyalova, D. V. (Inst. of People's Economy, Moscow). Prikl. Biokhim. Mikrobiol.; 9: 640-644(1973). (In Russian)

The effect of ultraviolet irradiation on the bacterial flora of fresh and slimy meat was investigated. Ultraviolet irradiation showed a high bactericidal action on bacteria that developed on meat and produced its rot: 5 min irradiation destructed 99% of all bacteria. It seems promising to irradiate cooled meat in order to prevent its rot. Irradiated meat should be infected with as possible as low number of microorganisms: the lower the number, the more effective ultraviolet irradiation with the same dosage. (auth)

5708 ISOLATION AND CHARACTERIZATION OF PROPHAGE MUTANTS OF THE DEFECTIVE BACILLUS SUBTILIS BACTERIOPHAGE PBSX. Thurm, P.; Garro, A. J. (City Univ. of New York, NY). J. Virol.; 16: No. 1, 184-191(Jul 1975).

Bacillus subtilis mutants with lesions in PBSX prophage genes have been isolated. One of these appears to be a regulatory mutant and is defective for mitomycin C-induced derepression of PBSX; the others are defective for phage capsid formation. All of the PBSX structural proteins are synthesized during induction of the capsid defective mutants; however, several of these proteins exhibit abnormal serological reactivity with anti-PBSX antiserum. The two head proteins X4 and X7 are not immunoprecipitable in a mutant which fails to assemble phage head structures. In the tail mutant, proteins X5 and X6 are not immunoprecipitable, tails are not assembled, and a possible tail protein precursor remains uncleaved. The noninducible mutant does not synthesize any PBSX structural proteins after exposure to mitomycin C. The mutation is specific for PBSX since phi 105 and SPO2 lysogens of the mutant are inducible. All of the known PBSX-specific mutations were shown to be clustered between argC and metC on the host chromosome. In addition, the metC marker was shown to be present in multiple copies in cells induced for PBSX replication. This suggests that the derepressed prophage replicates while still integrated and that replication extends into the adjacent regions of the host chromosome. (auth)

5709 CONTROL OF THYMIDINE KINASE SYNTHESIS IN IHD VACCINIA VIRUS-INFECTED THYMIDINE KINASE-DEFICIENT LM CELLS. Zaslavsky, V.; Yakobson, E. (Weizmann Inst. of Science, Rehovoth, Israel). J. Virol.; 16: No. 1, 210-213(Jul 1975).

The synthesis of vaccinia virus-induced thymidine kinase is normally arrested several hours after infection. In thymidine kinase-deficient LM cells infected with IHD strain of vaccinia virus, arrest occurs whether or not viral DNA synthesis is inhibited. With virus inactivated by uv irradiation, enzyme synthesis takes place, but arrest is abolished. It is suggested that an early viral genetic function is responsible for the cessation of thymidine kinase synthesis. (auth)

5710 UV-INDUCED REVERSION OF A TEMPERATURE-SENSITIVE LATE MUTANT OF SIMIAN VIRUS 40 TO A WILD-TYPE PHENOTYPE. Cleaver, J. E.; Weil, S. (Imperial Cancer Research Fund, London). J. Virol.; 16: No. 1, 214-216(Jul 1975).

Irradiation of a simian virus 40 temperature-sensitive late mutant before infection of CV1 cells produces viruses that are phenotypically wild-type revertants. This probably occurs through suppression rather than true reversion because the revertants are produced at relatively high frequency and still have some properties of the original temperature-sensitive virus. (auth)

5711 MORPHOGENESIS OF BACTERIOPHAGE phi 29 OF BACILLUS SUBTILIS: CLEAVAGE AND ASSEMBLY OF THE NECK APPENDAGE PROTEIN. Tosi, M. E.; Reilly, B. E.; Anderson, D. L. (Univ. of Minnesota, Minneapolis). J. Virol.; 16: No. 5, 1282-1295(Nov 1975).

Each of the 12 neck appendages of the Bacillus subtilis bacteriophage phi 29 consists of a single protein molecular weight of about 75,000, and on the mature virion the appendages are assembled to the lower of two collars. The appendage protein is cleaved from a percursor protein, P(J), with a molecular weight of about 88,000. This cleavage is independent of neck assembly, occurring during infection by mutants that cannot synthesize the proteins of the upper and lower collars of the neck. The cleaved form of the appendage protein is efficientiy complemented in vitro to particles lacking appendages. Thus, cleavage of the appendage precursor protein apparently does not occur in situ on the maturing virus. (auth)

5712 EFFECT OF UV IRRADIATION ON TRANSDUCTION BY COLIPHAGE T1. Drexler, H.; Kylberg, K. J. (Wake Forest Univ., Winston-Salem, NC). J. Virol.; 16: No. 2, 264-266(Aug 1955).

Lysates of the virulent coliphage T1 transduce seven markers between strains of Escherichia coli with reproducible efficiencies which range from 10^{-7} to 10^{-5}. The ability of a uv-irradiated lysate to transduce Arg^+, Str/sup R/, Trp^+, Lac^+, and Pro^+ is 90 percent and Bio^+ is 99 percent inactivated by doses which inactivate plaque

formation of T1 by six orders of magnitude. A dose of irradiation which causes a 1- to 2-log drop in the titer of T1 stimulated Gal^+ transduction by two- to three-fold; no other marker tested was stimulated. Irradiation causes dislinkage of some co-transducible markers but not others. (auth)

5713 ROLE OF GENE 59 OF BACTERIOPHAGE T4 IN REPAIR OF UV-IRRADIATED AND ALKYLATED DNA IN VIVO. Wu, R.; Wu, J. L.; Yeh, Y. C. (Univ. of Arkansas, Little Rock). J. Virol.; 16: No. 1, 5-16 (Jul 1975).

Nonsense mutants in gene 59 (amC5, amHL628) were used to study the role of this gene in the repair of uv-damaged and alkylated DNA of bacteriophage T4 in vivo. The higher sensitivity to uv irradiation and alkylation of gene 59 mutants after exposure to these agents was established by a comparison of the survival fractions with wild type. Zonal centrifugal analysis of both parental and nascent mutant intracellular DNA molecules after uv irradiation showed that immediately after exposure the size of single-stranded DNA fragments was the same as the wild-type intracellular DNA. However, the capability of rejoining fragmented intracellular DNA was greatly reduced in the mutant. In contrast, the wild-type-infected cells under the same condition resumed DNA replication and repaired its DNA to normal size. Methyl methanesulfonate induced more randomly fragmented intracellular DNA, when compared to uv irradiation. The rate of rejoining under these conditions as judged from their sedimentation profiles was also greatly reduced in mutant-infected cells. Further evidence is presented that uv repair is not a simple consequence of arrested DNA replication, which is a phenotype of the mutant when infected in a nonpermissive host, Escherichia coli B (su^-), but rather that the DNA repair function of gene 59 is independent of the replication function. These and other data presented indicate that a product(s) of gene 59 is essential for both repair of uv lesions and repair of alkylation damage of DNA in vivo. It is suggested that gene 59 may have two functions during viral development: DNA replication and replication repair of DNA molecules. (auth)

5714 GENETIC MAP OF THE STAPHYLOCOCCAL BACTERIOPHAGE phi 11. Kretschmer, P. J.; Egan, J. B. (Univ. of Adelaide, South Australia). J. Virol.; 16: No. 3, 642-651 (Sep 1975).

Ten sus mutants of the staphylococcal bacteriophage phi 11, each a representative from a different complementation group, have been used in three-factor cross experiments. The results of these crosses indicate a circular genetic map for phi 11. Functional studies of the mutants have been limited to electron microscopic examinations of lysates after prophage induction (or infection). One gene is an early gene, five genes are concerned with tail formation; and three are concerned with head formation. The tenth gene is possibly a head gene. The contribution by phi 11 to the genomic content of the plasmid-phage hybrid phi 11de has been investigated. Phi 11de contains most of the late genes and appears to be missing a continuous phi 11 segment that includes the early gene flanked by two late genes. (auth)

5715 PROTEINS OF BACTERIOPHAGE phi 6. Sinclair, J. F.; Tzagoloff, A.; Levine, D.; Mindich, L. (Public Health Research Inst. of the City of New York, Inc.). J. Virol.; 16: No. 3, 685-695 (Sep 1975).

We investigated the protein composition of the lipid-containing bacteriophage phi 6. We also studied the synthesis of phage-specific proteins in the host bacterium Pseudomonas phaseolicola HB10Y. The virion was found to contain 10 proteins of the following molecular weights: P1, 93,000; P2, 88,000; P3, 84,000; P4, 36,800; P5, 24,000; P6, 21,000; P7, 19,900; P8, 10,500; P9, 8,700; and P10, less than 6,000. Proteins P3, P9, and P10 were completely extracted from the virion with 1 percent Triton X-100. Protein P6 was partially extracted. Proteins P8 and P9 were purified by column chromatography. The amino acid composition of P9 was determined and was found to lack methionine. Labeling of viral proteins with [^{35}S]methionine in infected cells indicated that proteins P5, P9, P10, and P11 lacked methionine. Treatment of host cells with uv light before infection allowed the synthesis of P1, P2, P4, and P7; however, the extent of viral protein synthesis fell off exponentially with increasing delay time between irradiation and infection. Treatment of host cells with rifampin during infection allowed preferential synthesis of viral proteins, but the extent of synthesis also fell off exponentially with increasing delay time between the addition of rifampin and the addition of radioactive amino acids. All of the virion proteins were seen in gels prepared from rifampin-treated infected cells. In addition, two proteins, P11 and P12, were observed; their molecular weights were 25,200 and 20,100, respectively. Proteins P1, P2, P4, and P7 were synthesized early, whereas the rest began to increase at 45 min post-infection. (auth)

5716 NONGENETIC COMPLEMENTATION OF GROUP V TEMPERATURE-SENSITIVE MUTANTS OF VESICULAR STOMATITIS VIRUS BY UV-IRRADIATED VIRUS. Deutsch, V. (Univ. of Paris, Orsay, France). J. Virol.; 15: No. 4, 798-805 (Apr 1975).

Cells infected with temperature-sensitive (ts) mutants of complementation group V of vesicular stomatitis virus (VSV) give an enhanced yield at nonpermissive temperature when co-infected or superinfected with uv-irradiated virus. Virions produced in these mixed infections are temperature sensitive and do not complement ts V45. Rescue of group V mutants is multiplicity dependent. It can occur in the presence of cycloheximide; kinetics of rescue are similar in the absence or in the presence of the drug. Rescue is due to nongenetic complementation and is interpreted as a trigger effect on maturation of a small quantity of biologically active protein V molecules provided by uv-irradiated virus. These results are confirmed by rescue of ts V45 by uv-irradiated, defective, interfering T particles. (auth)

5717 TEMPERATURE-SENSITIVE HOST RANGE MUTANTS OF HERPES SIMPLEX VIRUS TYPE 2. Koment, R. W.; Rapp, F. (Pennsylvania State Univ., Hershey). J. Virol.; 15: No. 4, 812-819 (Apr 1975).

Herpesviruses are capable of several types of infection of a host cell. To investigate the early events which ultimately determine the nature of the virus-host cell interaction, a system was established utilizing temperature-sensitive mutants of herpes simplex virus type 2. Four mutants have been isolated which fail to induce cytopathic effects and do not replicate at 39 C in hamster embryo fibroblast cells. At least one mutant is virus DNA negative. Since intracellular complementation is detectable between pairs of mutants, a virus function is known to be temperature sensitive. However, all four mutants induce cytopathic effects and replicate to parental virus levels in rabbit kidney cells at 39 C. This suggests that a host cell function, lacking or nonfunctional in HEF cells but present in rabbit kidney cells at 39 C, is required for the replication of these mutants in hamster embryo fibroblast cells at 39 C. Therefore, we conclude that these mutants are both temperature sensitive and exhibit host range properties. (auth)

5718 QUANTITATIVE ASSAY FOR TRANSFORMATION OF 3T3 CELLS BY HERPES SIMPLEX VIRUS TYPE 2. Duff, R.; Rapp, F. (Pennsylvania State Univ., Hershey). J. Virol.; 15: No. 3, 490-496 (Mar 1975).

The interaction of herpes simplex virus type 1 (HSV-1) and type 2 (HSV-2) with Swiss/3T3 cells was investigated. Virus-induced cytopathic effects developed in the absence of production of infectious virus. HSV-2 inactivated with uv light (2, 4, 6, and 8 min) also induced cell death in the absence of virus replication. Cell death was not detectable after infection by HSV-2 that had been inactivated by uv irradiation for 10, 12, and 14 min. 3T3 cells infected with uv-inactivated virus (10 and 12 min) continued to replicate past the contact-inhibited monolayer normally associated with these cells. Infection of 3T3 cells with uv-irradiated HSV-2 also induced the development of transformed foci. Transformed cells with an epithelioid or fibroblastoid morphology were identified and isolated. All HSV-2-transformed cell lines contained HSV-2-specific antigens detectable by immunofluorescence techniques. The maximum frequency of HSV-2-induced transformation was 3×10^5 PFU per transformed focus, and the observed transformation could be inhibited by pretreatment of the virus with specific antiserum. No type C particles were detected within five cell culture passages after transformation by HSV-2. Type C virus particles were detected after 10 cell culture passages of the HSV-2-transformed cell lines. (auth)

5719 INDUCTION OF HUMAN CELL DNA SYNTHESIS BY HERPES SIMPLEX VIRUS TYPE 2. Melvin, P.; Kucera, L. S. (Wake Forest Univ., Winston-Salem, NC). J. Virol.; 15: No. 3, 534-539 (Mar 1975).

The effect of herpes simplex virus type 2 (HSV-2) infection on the synthesis of DNA in human embryonic fibroblast cells was determined at temperatures permissive (37°C) and nonpermissive (42°C) for virus multiplication. During incubation of HSV-2-infected cultures at 42°C for 2 to 4 days or after shift-down from 42 to 37°C, incorporation of [^{3}H]TdR into total DNA was increased 2- to 30-fold as compared with mock-infected cultures. Analysis of the [^{3}H]DNA suggested that host cell DNA synthesis was induced by HSV-2 infection. Induction of host cell DNA synthesis by HSV-2 also occurred in cells arrested in DNA replication by low serum concentration. The three strains of HSV-2 tested were capable of stimulating cellular DNA synthesis. Virus inactivated by uv irradiation, heat, or neutral red dye and light did not induce cellular DNA synthesis, suggesting that an active viral genome is necessary for induction. (auth)

5720 ASSAY FOR EPSTEIN–BARR VIRUS BASED ON STIMULATION OF DNA SYNTHESIS IN MIXED LEUKOCYTES FROM HUMAN UMBILICAL CORD BLOOD. Robinson, J.; Miller, G. (Yale Univ., New Haven). J. Virol.; 15: No. 5, 1065-1072(May 1975).

Relationships between the rate of DNA synthesis in cultured human umbilical cord leukocytes and the multiplicity of added Epstein-Barr virus (EBV) were studied. At low multiplicities of approximately 0.1 transforming units/cell (approximately 10 physical particles/cell), inoculated cultures demonstrated increased rates of DNA synthesis, by comparison to uninoculated cultures, 3 days after inoculation. Stimulation of DNA synthesis was evident at progressively longer intervals after inoculations of 10-fold dilutions of virus. The rate of DNA synthesis, determined by short [^{3}H]thymidine pulses, reflected as small as two-fold changes in multiplicity and thus can serve as a quantitative assay for the virus. Changes in the rate of DNA synthesis were evident before increases in cell number or alteration in morphology. Stimulation of DNA synthesis in umbilical cord leukocytes was inhibited by treatment of EBV with antibody and also in graded fashion, by progressive doses of uv irradiation to the virus. Induction of DNA synthesis by EBV was serum dependent. Estimates of the number of cells transformed were obtained by extrapolation from a standard curve relating known numbers of transformed cells to [^{3}H]thymidine incorporation and also by cloning cells after exposure to virus. At the low multiplicities of infection used in these experiments approximately 0.04 to 0.002 of the total cellular population was transformed. The high efficiency of cell transformation by EBV by comparison to other DNA tumor viruses is emphasized. (auth)

5721 EFFECT OF UV LIGHT ON RNA-DIRECTED DNA POLYMERASE ACTIVITY OF MURINE ONCORNAVIRUSES. Lovinger, G. G.; Ling, H. P.; Gilden, R. V.; Hatanaka, M. (Flow Labs, Inc., Rockville, MD). J. Virol.; 15: No. 5, 1273-1275(May 1975).

The uv inactivation of RNA-directed DNA polymerase activity of Rauscher leukemia virus was shown to be due to damage to the protein. The uv dose resulting in 37 percent survival of viral polymerase activity at 254 nm was 2.4×10^4 to 3.1×10^4 ergs/mm^2. The inactivation rate of p30, a major internal viral protein, was much slower. (auth)

5722 ANALYSIS OF URIDINE INCORPORATION IN CHICKEN EMBRYO CELLS INFECTED BY VESICULAR STOMATITIS VIRUS AND ITS TEMPERATURE-SENSITIVE MUTANTS: URIDINE TRANSPORT. Genty, N. (Univ. of Paris, Orsay, France). J. Virol.; 15: No. 1, 8-15(Jan 1975).

The shut-off of RNA synthesis in chicken embryo cells, after infection with vesicular stomatitis virus, is partially due to a reduced capacity of the infected cells to transport uridine. Permeability to uridine decreases exponentially after infection. This loss of ability to transport uridine may be caused either by structural components of the input virions or may result from the expression of the viral gene products. In the latter case, only minor levels of viral transcription are sufficient to modify cellular permeability, since, even at low multiplicities, RNA$^-$ temperature-sensitive (ts) mutants of vesicular stomatitis virus bring about a significant diminution of uridine incorporation in cells infected under nonpermissive conditions. Experiments with mutants of group III suggest that the M protein of the viral envelope may play a role in the sequence of events that modifies uridine transport. In addition to this cause of the diminution of incorporation of uridine by infected cells, another mechanism is noted which requires protein synthesis. (auth)

5723 CHARACTERIZATION OF A BACTERIOPHAGE T4 MUTANT LACKING DNA-DEPENDENT ATPase. Behme, M. T.; Ebisuzaki, K. (Univ. of Western Ontario, London). J. Virol.; 15: No. 1, 50-54(Jan 1975).

A DNA-dependent ATPase has previously been purified from bacteriophage T4-infected Escherichia coli. A mutant phage strain lacking this enzyme has been isolated and characterized. Although the mutant strain produced no detectable DNA-dependent ATPase, growth properties were not affected. Burst sizes were similar for the mutant phage and T4D in polA1, recB, recC, uvrA, uvrB, uvrC, and various DNA-negative E. coli. UV sensitivity and genetic recombination were normal in a variety of E. coli hosts. Mapping data indicate that the genetic locus controlling the mutant occurs near gene 56. The nonessential nature of this gene is discussed. (auth)

5724 DNA INFECTIVITY AND THE INDUCTION OF HOST DNA SYNTHESIS WITH TEMPERATURE-SENSITIVE MUTANTS OF SIMIAN VIRUS 40. Chou, J. Y.; Martin, R. G. (National Inst. of Arthritis, Metabolism, and Digestive Diseases, Bethesda, MD). J. Virol.; 15: No. 1, 145-150(Jan 1975).

Host DNA synthesis is induced when CV-1 (monkey kidney) cell cultures are infected at 40^{0}C with wild-type virions or with temperature-sensitive Simian virus 40 mutants of the "early" complementation group A. Host DNA synthesis is not induced when cultures are infected with mutants of the late complementation group D. The simplest explanation for these observations, that induction depends not upon the expression of some early gene function but rather on the presence of an active D protein in the infecting virion, has been examined. Indirect experiments suggest that this explanation is not correct. Moreover, the induction of host DNA synthesis is impaired when cultures are infected with mutants of the A group at 42.5^{0}C rather than 40^{0}C, suggesting that the A function may be responsible for host induction. The inability of D virions to induce host DNA synthesis may reflect their inability to uncoat at 40^{0}C. (auth)

5725 TEMPERATURE SENSITIVE MUTANTS OF SIMIAN VIRUS 40 SELECTED BY TRANSFORMING ABILITY. Yamaguchi, N.; Kuchino, T. (Univ. of Tokyo). J. Virol.; 15: No. 6, 1297-1301(Jun 1975).

Eight temperature-sensitive mutants of simian virus 40 which transform rat cells at 32.5^{0}C but not at 38.5^{0}C have been isolated. All the mutants were also temperature sensitive for replication in African green monkey kidney cells and five of them were classified into a single complementation group. No mutant incapable of transforming rat cells at either temperature was isolated. (auth)

5726 POSSIBILITIES OF IN VIVO AND IN VITRO REACTIVATION OF HEAT INACTIVATED VACCINIA VIRUS. Babbar, O. P.; Chowdhury, B. L. (Central Drug Research Inst., Lucknow, India). Indian J. Exp. Biol.; 13: No. 4, 378-383(Jul 1975).

Suspensions of heat inactivated (60°C for 12 min) vaccinia virus (HVV) were reactivated in ova by suspensions of uv irradiated vaccinia virus (IVV). Reactivation was maximum when IVV suspension was given 4 hr before HVV suspension, and even then only one out of every 30 potential pock forming units could be reactivated. Cell lysates, prepared from chorioallantoic membrane (CAM) cultures infected with VV, IVV, or HVV at different intervals of infection, showed that only those made from CAM cultures infected with VV or IVV (VL) had a high concentration of lytic enzymes at 4 hr of infection, but they lacked the pock forming ability. This concentrated cell lysate VL, however, reactivated in vitro HVV suspensions, and when reactivation was maximum only one out of 3000 potential reactivable pock forming units (PFU) in 20% of the suspensions, could be reactivated. Cell lysate VL could trim off in vitro the HA (haemagglutimation) units from the infective vaccinia virus particles (VV) and the resulting PFU which was destroyed by DNase or by freezing, was not neutralized by virus specific antisera. (auth)

5727 SENSITIVITY TO UV TREATMENT AND NUCLEAR SIZE OF MYCOPLASMA-LIKE ORGANISM INFECTED HUMICOLA SP. Lepidi, A. A.; Filippi, C.; Giovannetti, M.; Nuti, M. P. (Univ., Pisa, Italy). Experientia; 31: No. 10, 115-1157 (15 Oct 1975).

The infection of MLO in a soil microfungus (Humicola sp.) originates different types of non-lethal parasitism. Differences have been found in the uv sensitivity and nuclear characters according to the type of MLO-microfungus interrelationship. (auth)

5728 EFFICACY OF THE INACTIVATION OF BACTERIAL SPORES IN WHITE PETROLATUM AND A HYDROPHILIC OINTMENT BY GAMMA IRRADIATION. Ceie, S. H.; Fystro, D. (National Inst. of Public Health, Oslo). Appl. Microbiol.; 30: No. 4, 514-518(Oct 1975).

To evaluate the possibilities of using gamma irradiation for the sterilization of ointments, the effect of irradiation on spores of Bacillus pumilus and Bacillus sphaericus in dry material and in two different kinds of ointments was studied. The results indicate that for sterilization purposes irradiation was less effective in white petrolatum as compared to irradiation in the dry state. No such protective effect was found in a hydrophilic ointment. Accordingly, the sterilization dose needed for the sterilization of an ointment can be decided upon only after inactivation experiments with suitable test organisms in the actual preparation. (auth)

5729 GENETIC AND PHYSIOLOGICAL CHARACTERIZATION OF MET15 MUTANTS OF SACCHAROMYCES CEREVISIAE: A SELECTIVE SYSTEM FOR FORWARD AND REVERSE MUTATIONS. Singh, A.; Sherman, F. (Univ. of Rochester, NY). Genetics; 81: No. 1, 75-97(Sep 1975).

One hundred and thirty-three spontaneous and induced mutants of the met15 locus in Saccharomyces cerevisiae were characterized with respect to temperature sensitivity, osmotic remediability, interallelic complementation, and suppressibility by amber and ochre suppressors. Forty mutants are osmotic remedial; 17 of these, and no others, are also temperature-sensitive. Seven of

133 mutations are suppressible by an amber suppressor and 11 are suppressible by an ochre suppressor. Seventy percent of the mutants exhibited interallelic complementation, suggesting that the functional gene product of the met15 gene is a multimeric protein. Relative map positions of 30 met15 were estimated from the frequencies of x-ray-induced mitotic reversion of various heteroallelic diploids. All complementing nonsense mutations are located near one end of the gene in contrast to other nonsense mutations which span most of the gene, thus relating the direction of translation of the mRNA with respect to the fine-structure map. Recombination studies indicated that two of 30 mutants contained deletions of the entire met15 locus. It was established that a variety of mutational types, including missense, nonsense, and deletions, are recovered with this unique system in which both forward and reverse mutations can be selected on the basis of methyl mercury resistance and methionine requirement of the met15 mutants. (auth)

5730 DELETION MAP OF CYC1 MUTANTS AND ITS CORRESPONDENCE TO MUTATIONALLY ALTERED ISO-1-CYTOCHROMES C OF YEAST. Sherman, F.; Jackson, M.; Liebman, S. W.; Schweingruber, A. M.; Stewart, J. W. (Univ. of Rochester, NY). Genetics; 81: No. 1, 51-73(Sep 1975).

Mutants arising spontaneously from sporulated cultures of certain strains of yeast, Saccharomyces cerevisiae, contained deletions of the CYC1 gene which controls the primary structure of iso-1-cytochrome c. At least 60 different kinds of deletions were uncovered among the 104 deletions examined and these ranged in length from those encompassing only two adjacent point mutants to those encompassing at least the entire CYC1 gene. X-ray-induced recombination rates of crosses involving these deletions and cyc1 point mutants resulted in the assignment of 211 point mutants to 47 mutational sites and made it possible to unambiguously order 40 of these 47 sites. Except for one mutant, cyc1-15, there was a strict colinear relationship between the deletion map and the positions of 13 sites that were previously determined by amino acid alterations in iso-1-cytochromes c from intragenic revertants. (auth)

Radiation Effects on Plants

Refer also to abstracts 5687 and 5761.

5731 (ERDA-tr-51, pp 165-167) CHANGE IN THE RADIOSENSITIVITY OF PLANTS UNDER THE INFLUENCE OF GROWTH REGULATORS. Kryukova, L. M. (Academy of Sciences USSR, Pushchino). 1975. Translated from Radiobiologiya; 15: No. 2, 317-318(1975).

In Radiobiology.

The role of radiation-induced inhibitors in the change in the radiosensitivity of plants was studied in gamma-irradiated corn plants. Chlorogenic and caffeic acid in concentrations characteristic of intact plants were used as the natural inhibitors. Extracts from leaves of irradiated black bean plants were used as induced inhibitors. It was found that the inhibitors induced by ionizing radiation, representing oxidized phenolic compounds, participate actively in the metabolism of the plants, and under definite conditions exhibit a protective action, increasing the radioresistance of the plants on account of an inhibition of metabolic processes. (ERB)

5732 (ERDA-tr-51, pp 168-171) STUDY OF THE EFFECTIVENESS OF GAMMA IRRADIATION OF THE SAFFRON. Akhund-Zade, I. M.; Muzaferova, R. Sh. (Academy of Sciences Azerbaidzhan SSSR, Baku). 1975. Translated from Radiobiologiya; 15: No. 2, 319-322(1975).

In Radiobiology.

Corms of the saffron Crocus sativus L., an important aromatic spice crop, weighing 10 to 12 g with a moisture content 16.5 to 17.0 percent, were irradiated with the gamma rays of ^{137}Cs on a Stebel-3 apparatus, at a dose rate of 740 R/min, at doses of 0.1, 0.25, 0.5, 1, 2, 4, 8, 16, and 20 kR. The experiments were repeated twice, with 50 corms in each variation. The corms were planted at a depth of 15 cm. The criteria of radiosensitivity were chromosome rearrangements in meristem cells of primary roots, counted on temporary acetocarmine preparations, and the growth and development of the plants. The yield of stigmas and tuber formation were determined according to years of development. The dried stigmas were collected in bottles with a ground stopper, and after collection the yield was weighed. At the end of the vegetation, the yield of corms was determined, and the coefficient of reproduction was derived; in addition, the yield of large, medium, and small corms was evaluated. The indices were estimated by a continuous method with all the plants. The numerical material was subjected to biometric treatment. It was found that preplanting irradiation of saffron corms at doses of 0.25 and 0.5 kR can lead both to an increase in the production of stigmas and to an increase in the amount and quality of the planting material. (ERB)

5733 PRESERVATION OF FRUITS AND VEGETABLES BY IRRADIATION. Azamar, B. J. A. (Universidad Nacional Autonoma de Mexico, Mexico City); Carrasco, A. H.; Cabrera, M. L.; de Fernandez, M. V. G.; Loyola, V. V. M. Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 53(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Radiation Effects on Animals

5734 SIMPLIFIED INTERSTITIAL THERAPY TECHNIQUE ("VICRYL" ^{125}I) FOR UNRESECTABLE LUNG CANCER. Scott, W. P. (Charlotte Memorial Hospital, NC). Radiology; 117: No. 3, 734-735(Dec 1975).

A simple technique of permanent radioactive implantation, originally developed for the increasing number of unresectable lung tumors, utilizes absorbable polyglactin sutures ("Vicryl") containing low intensity, long half-life ^{125}I seeds. (auth)

Man

5735 (DHEW/FDA-76-8015) SYSTEM FOR ESTIMATION OF MEAN ACTIVE BONE MARROW DOSE. Ellis, R. E.; Healy, M. J. R.; Shleien, B.; Tucker, T. (Bureau of Radiological Health, Rockville, Md. (USA)). Sep 1975. 50p. GPO $1.15.

The exposure measurements, model and computer program for estimation of mean active bone marrow doses formerly employed in the 1962 British Survey of x-ray doses and proposed for application to x-ray exposure information obtained in the U.S. Public Health Service's X-Ray Exposure Studies (1966 and 1973) are described and evaluated. The method described is feasible for use to determine the mean active bone marrow doses to adults for examinations having a skin to source distance of 80 cm or less. For a greater SSD, as for example in chest x rays, a small correction in the calculation dose can be made. (auth)

5736 (ERDA-tr-51, pp 110-112) INFLUENCE OF GAMMA IRRADIATION ON COMPLEXES OF PROGESTERONE WITH THE PROTEIN RECEPTOR OF THE NUCLEUS AND CYTOPLASM OF CELLS OF THE HUMAN ENDOMETRIUM. Mal'tsev, A. V. (Academy of Sciences USSR, Pushchino). 1975. Translated from Radiobiologiya; 15: No. 2, 273-275(1975).

In Radiobiology.

The question of the degree to which complexes of steroids with cytoplasmic and nuclear protein receptors are sensitive to ionizing radiation has not been clarified. In view of this, the state of the progesterone-receptor complexes (PRC) of the human endometrium after gamma irradiation was studied. The data show that in the nuclear fraction of the human endometrium, the specific complex of ^{3}H-progesterone with the protein receptor consists of two fractions differing in radiosensitivity. Most likely the PRC of the nuclear fraction of the human endometrium contains three to four or more fractions which are detected using various physicochemical methods. (ERB)

5737 (LA-UR--75-1872) DOSIMETRY OF PION BEAMS. Dicello, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 40p. (CONF-751060--1). Dep. NTIS $5.50.

From international particle radiation therapy workshop; Key Biscayne, Florida, USA (1 Oct 1975).

Negative pion beams are probably the most esoteric and most complicated type of radiation which has been suggested for use in clinical radiotherapy. Because of the limited availability of pion beams in the past, even to nuclear physicists, there exist relatively fewer basic data for this modality. Pion dosimetry is discussed. (CH)

5738 (LA-UR--75-1873) PHYSICAL PROPERTIES OF CHARGED PARTICLE BEAMS FOR USE IN RADIOTHERAPY. Knapp, E. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 20p. (CONF-751060--2). Dep. NTIS $4.50.

From international particle radiation therapy workshop; Key Biscayne, Florida, USA (1 Oct 1975).

The physical properties of the possible charged particle beams used for cancer radiotherapy are reviewed. Each property is discussed for all interesting particles (pi, p, alpha, Ne ion) and the differences are emphasized. This is followed by a short discussion of the several beam delivery systems used in particle

therapy today, emphasizing the differences in the problems for the several different radiations, particularly the differences between the accelerated particle beams and those of a secondary nature. Dose calculation techniques are described. (CH)

5739 (ORO-4002-4) EFFECTS OF X-IRRADIATION ON THE HUMAN TESTIS: AN ELECTRON MICROSCOPIC CYTOCHEMICAL STUDY. Terminal Report, 1969–1974. Berlin, J. D. (Texas Tech Univ., Lubbock (USA)). 1974. Contract AT(40-1)-4002. 44p. Dep. NTIS $5.00.

Results are reported from studies on the effects of various doses and dose rates of x radiation on the cytology and function of the human testis. Tissue samples from testicular biopsies were examined for changes in the fine structure of the cells and enzyme localization and activity. Data are included on acid phosphatase, thiamine pyrophosphatase, inosine diphosphatase, glucose-6-phosphatase, and adenosine mono- or triphosphatase. The fine structural localization of phosphatases in the normal human testis was also determined. (CH)

5740 RADIATION AND DRUG TREATMENT OF NEGLECTED FORMS OF LARYNX CANCER. Morozov, A. I.; Rogachikova, T. A.; Devyatykhh, Yu. N. (Moscow Regional Scientific-Research Clinical Inst.). Med. Radiol.; 20: No. 10, 27-32(Oct 1975). (In Russian)

On the basis of the experience of treatment of 45 patients with neglected forms of larynx cancer, the use of radiation and chemotherapeutic components, indications, and contraindications to chemo-radiation treatment were discussed. The expediency of this treatment in spreading of tumoral process over the larynx was established as well as metastatic spreading to lymph nodes of the neck, and to remote organs. The irradiation doses were 4500 to 6000 rad, simultaneously with radiation treatment and after its completion the authors prescribed thioTEF (14 patients) cyclophosphan (11 patients), spirazidin (11), peutsedanin (7), sarcolysin (2). The use of thioTEF, cyclophosphan and spiradizin was most expedient in chemoradiation treatment. In spite of the fact that 33 patients out of 45 had the IV stage of the disease, a 3-year survival comprised 55.5 per cent, a 5 year one, 40 per cent. A conclusion was drawn about the expediency of irradiation through grid filters that reduces general and local radiation reactions and makes it possible to conduct radiation and chemotherapy simultaneously. Tactics of chemo-radiation treatment should be strictly individualized. (auth)

5741 GREATER OMENTUM IN REPAIR OF COMPLICATIONS FOLLOWING SURGERY AND RADIOTHERAPY FOR CERTAIN CANCERS. Abbes, M. J. L.; Richelme, H.; Demard, F. Int. Surg.; 59: No. 2, 81-86(Feb 1974).

Transposition of greater omentum (G.O.) from the abdominal cavity to repair sequelae of combined surgical and radiotherapeutic treatment of cancer in four cases has been presented. One axillary radionecrosis and three oropharyngostomas developed after extensive reconstructive surgery following radiotherapy. The theoretical possibilities for using this method are developed by reviewing the attributes of the G.O. (anti-infectious, immune, and trophic). The technical aspects of lengthening it in order to reach the neck, armpit or scalp are then analyzed. Favorable results agree with the use of G.O. in other domains. (auth)

5742 CLINICAL EXPERIENCE WITH SUPERVOLTAGE RADIOTHERAPY IN CARCINOMA OF THE PROSTATE: A PRELIMINARY REPORT. Mollenkamp, J. S.; Cooper, J. F.; Kagan, A. R. (Kaiser Foundation Medical Center, Los Angeles). J. Urol.; 113: No. 3, 374-377(Mar 1975).

A review was done on 88 cases of carcinoma of the prostate treated with supervoltage radiotherapy and evaluated at regular intervals with post-treatment needle biopsies. A disturbing 58 percent (45 of 77 cases) had histologic evidence of residual carcinoma at 1 year post-radiation. In 47 percent (21 of 45 cases) of patients receiving 7,000 to 7,500 R the biopsies were positive. No undue morbidity was experienced with radiation levels at 7,000 R. Prostatic needle biopsy is considered mandatory for adequate clinical evaluation post-radiation. Since 41 percent of patients judged radioresponsive on rectal palpation had positive biopsies at 12 months the data indicate considerable error in the clinical assessment of the irradiated prostate when reliance is placed solely on digital evaluation. (auth)

5743 EXTENDED BIOPSY FOLLOWUP AFTER FULL COURSE RADIATION FOR RESECTABLE PROSTATIC CARCINOMA. Sewell, R. A.; Braren, V.; Wilson, S. K.; Rhamy, R. K. (Vanderbilt Univ., Nashville). J. Urol.; 113: No. 3, 371-373 (Mar 1973).

Extended biopsy followup of 17 relatively young men with resectable prostatic cancer treated by external supervoltage radiotherapy is presented. Although six of the eight surviving patients now have negative biopsies, the over-all survival rate and the over-all incidence of negative biopsies are not so encouraging, with only 35 percent rendered free of tumor. Thus, the role of radiotherapy in resectable prostatic carcinoma should be critically scrutinized. More accurate staging is needed. Hopefully, more sophisticated studies of diagnostic and prognostic value will be available in the near future. (auth)

5744 TELECOBALT THERAPY FOR PROSTATIC CANCER: RATIONALE, RESULTS, AND FUTURE CONSIDERATIONS. McLoughlin, M.; Hazra, T.; Schirmer, H. K. A.; Scott, W. W. (Johns Hopkins Hospital, Baltimore). J. Urol.; 113: No. 3, 378-379(Mar 1975).

External supervoltage radiation is now an accepted form of treatment for adenocarcinoma of the prostate but the tumor response cannot be predicted. We hope in the future that accurate clinical staging coupled with a biological staging of the tumor cells with catalase activity will enable us to predict this response. Ionizing radiations act by producing active radicals, hence the rationale of studying the tissue catalase activity in conjunction with the histological grading may provide a more accurate index of patients who would gain the most benefit from radiotherapy. (auth)

5745 RESULTS OF RADIOTHERAPY FOR CERVIX CARCINOMA AT THE GYNECOLOGICAL HOSPITAL DRESDEN-FRIEDRICHSTADT IN 1950–1967. III. Goebel, G.; Goebe, L. Zentralbl. Gynaekol.; 96: No. 51, 1618-1623(20 Dec 1974). (In German)

We have got a report about 1744 initially irradiated patients. Between 1950 to 1961 Radium was introduced in 4 to 5 applications, from 1962 to 1967 only 2 or 3 applications were carried out with unchanging total quantity of about 5000 to 7000 mgeh Radium. While in the beginning the 5-areal technique of the conventional irradiation field in the erect position was carried out, from 1962 to 1967 the 7-field technique was applicated. A relative 5 year number of cures was reached in 38.8% (from 1950 to 1961: 38.4%; from 1962 to 1967: 40.4%). The primary mortality of irradiated patients was rather low (1.6%). Fistulae appeared in 7.8% of cases and late damages of irradiation were registered in 6.3% of cases. (auth)

5746 RESULTS OF THE RADIATION TREATMENT OF THE CERVIX UTERI AND UTERINE CANCER IN ADVANCED AGE. Woraschk, A.; Glueck, S.; Seifert, B. (Martin-Luther-Univ., Halle-Wittenberg, Ger.). Zentralbl. Gynaekol.; 96: No. 41, 1300-1304(11 Oct 1974).

Report on 316 patients with cancer of the cervix uteri and 144 patients with cancer of the corpus uteri of the years 1962 to 1971, which were treated exclusively radiologically. The age of the patients was between 65 and 91 years. The results of the treatment are analyzed, taking into consideration the age of the patients, the normal expectation of life and the stages of the cancer. (auth)

5747 IRREVERSIBLE LOSS OF NEGATIVE SURFACE CHARGE AND LOSS OF COLONY-FORMING ABILITY IN BURKITT LYMPHOMA CELLS AFTER X IRRADIATION. Sato, C.; Kojima, K. (Aichi Cancer Center Research Inst., Nagoya, Japan). Exp. Cell Res.; 69: 435-439(Dec 1971).

The electrokinetic behavior of Burkitt lymphoma P 3H-R1 cells were studied following x irradiation. The surface charge of irradiated cells decreased progressively with time after x-ray treatment, as compared with a mean mobility value (-0.677 ± 0.045 μsec^{-1} V^{-1} cm) of non-irradiated cells. The frequency distribution of cells treated with 3,000 R 4 h previously showed quite a different peak of lower mobility than that of non-irradiated cells with the boundary of -0.550 μsec^{-1} V^{-1} cm. Percentages of cells which showed the higher mobility than the boundary value 4 h after irradiation with 30, 50, 65, 100, 200, or 3,000 R were in accord with the percentage of cells which showed colony-forming ability in soft agar, respectively. Following cell proliferation the population of electrokinetically intact cells increased with time after irradiation; these values also coincided with the population of colony-forming cells. Thus, the present results indicate that there is a close relation between loss of negative surface charge and loss of colony forming ability in irradiated cells, suggesting that loss of colony forming ability of the cells may be determined as early as 4 h after irradiation. (auth)

5748 SERUM β-GLUCURONIDASE ACTIVITY IN URANIUM WORKS MINERS. Nosek, J.; Pehr, F. Cas. Lek. Cesk.; 114: No. 4, 114-117(1975). (In Czech)

Venous blood serum-beta-glucuronidase activity (EC 3. 2. 1. 31) was established in uranium works miners and control group. Significant decrease in beta-glucuronidase activity was found in the early, gradual normalization over the middle and gradual significant increase in the late period of the miner's working years. A survey of the authors' earlier findings concerning exchange and metabolism of various substances in the venous blood

erythrocytes of uranium works miners is presented. It is suggested that the present changes in serum beta-glucuronidase activity document changes also in cells of other tissues of the miner's organism than erythrocytes. Probable causes of the above changes are discussed. (auth)

5749 POTENTIAL CREW HAZARDS DUE TO RADIOACTIVE CLOUD PENETRATIONS. Patrick, R. P. (Air Force Weapons Lab., Kirtland Air Force Base, NM). Aviat., Space Environ. Med.; 46: No. 3, 281-289(Mar 1975).

Potential crew hazards resulting from radioactive cloud penetrations are investigated and the seriousness of each potential hazard is discussed. Preventive measures to alleviate the potential hazards are discussed. (auth)

5750 COMPARISON OF ^{137}Cs IRRADIATION AND MITOMYCIN C TREATMENT OF STIMULATOR CELLS IN THE MIXED LYMPHOCYTE CULTURE REACTION. Lightbody, J.; Kong, Y. C. M. (Wayne State Univ., Detroit). Cell. Immunol.; 13: No. 2, 326-330(Aug 1974).

Cesium-137 irradiation has been compared with mitomycin C treatment for the inhibition of DNA synthesis in the one-way mixed lymphocyte culture (MLC) reaction in mice and humans. Cesium-137 irradiation was found to be as effective as mitomycin C in preventing cell proliferation without interfering with the ability of the cell to stimulate allogeneic cells in MLC. (auth)

5751 THYMIC IRRADIATION: AN APPROACH TO CHRONIC LYMPHOCYTIC LEUKEMIA. Richards, F. II; Spurr, C. L.; Pajak, T. F.; Blake, D. D.; Raben, M. (Wake Forest Univ., Winston-Salem, NC). Am. J. Med.; 57: 862-869(Dec 1974).

Twenty-two patients with active chronic lymphocytic leukemia were treated with thymic irradiation; a full remission was achieved in 14 and a partial response in 7. In a similar group of 28 patients treated with chlorambucil, there were 7 full remissions, 5 partial responses, 6 with white cell control and 10 with no response. Thymic irradiation restored the leukocyte count to normal in 76 percent of the cases (16 of 21) and the differential in 32 percent (7 of 22), with complete resolution of lymphadenopathy in 81 percent (17 of 21), hepatomegaly in 75 percent (12 of 16), splenomegaly in 76 percent (11 of 14) and symptoms in 100 percent (20 of 20). Chlorambucil restored the leukocyte count to normal in 50 percent (14 of 28) and the differential in 7 percent (2 of 28), with complete resolution of lymphadenopathy in 43 percent (9 of 21), hepatomegaly in 43 percent (9 of 21), splenomegaly in 24 percent (4 of 22) and symptoms in 64 percent (16 of 25). Thymic irradiation produced a more rapid response even in patients resistant to chemotherapy and was more effective (11 of 12 or 92 percent) than chlorambucil (7 of 22 or 33 percent) in patients with hematocrit readings of less than 30 percent and/or greater than 75 percent infiltration of the bone marrow and a leukocyte count of more than 40,000 cells/mm^3 and in patients with splenomegaly. Anemia was corrected in all three patients and thrombocytopenia in two of six patients treated with thymic irradiation. Chlorambucil corrected anemia in 2 of 11 patients and thrombocytopenia in 2 of 5 patients. Anemia developed in 5 of 17 patients and thrombocytopenia in 4 of 23 patients treated with chlorambucil and in no patients treated with thymic irradiation. (auth)

5752 POST RADIATION BONE SARCOMA. Potdar, G. G.; Shrikhande, S. S. (Tata Memorial Hospital, Bombay). Indian J. Cancer; 10: 361-365(Sep 1973).

Criteria for diagnosis of a tumor as radioinduced bone sarcoma are presented and a case report that fulfills the criteria is described. A discussion is presented of mechanisms by which radioinduced bone sarcomas are produced, dose response relationships, and treatment of bone sarcomas. (HLW)

5753 TELECOBALT THERAPY OF BRONCHOGENIC CARCINOMA. Putnik, D.; Merkas, Z.; Vanic, D.; Sobic, V. Plucne Boles. Tuberk.; 26: No. 2, 350-353(1974). (In Slovak).

A group of 98 patients with inoperable, mostly far advanced carcinoma was treated by telecobalt therapy applied as a unique method of treatment. In the observed group of patients, direct favorable effect appeared in 90 cases. The subjective improvement was evident in all of them but three, and objective revealed improvement was found in 69 cases. The number of survivors at the last check-up examination in April 1971 amounted up to only 18, out of which 6 survived up to one year, another 6 up to two and the remaining 6 from two to four years after the completed therapy. Results of treatment are not greatly encouraging. In order to achieve a better effect it might be necessary to combine radiation with cytostatics for the preparatory, simultaneous or subsequent treatment by these methods. (auth)

5754 SOME HEALTH ASPECTS OF HIGH-ENERGY SOCIETY. Cook, E. (Texas A and M Univ., College Station). Tex. Rep. Biol. Med.; 33: No. 1, 25-44(1975).

The intensive use of inanimate energy in industrialized or high-energy society has subsidized research, development, and higher education and has brought about changes in nutrition and life-style that have led to great advances in public health and medicine. The emergence of high-energy society, however, has brought with it a new set of health problems, within which the direct effects of measurable pollution may turn out to be more easily dealt with than some of the indirect and hard-to-calculate consequences of high energy use. High-energy society is critically dependent on energy-intensive transport systems, and these systems in turn are dependent upon a continual supply of petroleum products. In the short-term, the aorta of any industrialized nation is its petroleum-supply network. In the longer run, high-energy society faces the depletion and exhaustion of all the non-renewable resources on which it has fed. Even if technology provides adequate substitute energy systems, high-energy society may deteriorate socially from inability to cope with affluence. (auth)

5755 POSTIRRADIATION ATROPHIC CHANGES OF BONE AND RELATED COMPLICATIONS. Howland, W. J.; Loeffler, R. K.; Starchman, D. E.; Johnson, R. G. (Aultman Hospital, Canton, OH). Radiology; 117: No. 3, 677-685(Dec 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago (1 Dec 1974).

The sequence of radiographically visible changes about the shoulder girdle following irradiation was analyzed in 49 patients who received 200 kV irradiation, in 50 who received 25 MeV betatron photon irradiation, and in 20 who received cobalt-60 gamma irradiation. The changes were dose related and were most evident in the kilovoltage group, but also occurred following megavoltage therapy. Atrophic changes may be complicated by fracture, true necrosis, true osteitis, or sarcoma. These atrophic changes have clinical significance similar to the atrophic changes that occur in skin and mucous membranes. The terms radionecrosis and radiation osteitis as applied to these changes should be abandoned since they imply a more serious process than is actually present. Biopsy should be avoided if possible since trauma and secondary infection could lead to true necrosis. (auth)

5756 MECHANISM AND ROLE OF IMMUNOLOGICAL TOLERANCE. Hraba, T. Monographs in Allergy, Volume 3. New York; S. Karger (1968). 136p.

Studies on immunological tolerance are reviewed. Some topics discussed are: natural occurrence of transplantation tolerance; tolerance to heterologous serum proteins; role of age of the recipient in induction of tolerance; effects of radiation and immunosuppressive drugs on induction of tolerance; the role of antigen in maintaining tolerance; immune deviation; immune reactions during induction of tolerance; immune reactions after disappearance of tolerance; genetic determination of immune reaction; and occurrence of autoimmune reactions. (HLW)

5757 ROLE OF RADIOTHERAPY IN RENAL INVOLVEMENT IN ACUTE CHILDHOOD LEUKEMIA. Stoffel, T. J.; Nesbit, M. E.; Levit, S. H. (Univ. of Minnesota, Minneapolis). Radiology; 117: No. 3, 687-694(Dec 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL, USA (1 Dec 1974).

Twenty-one children with acute leukemia received irradiation to the renal area for the following reasons: hypertension (2 patients); oliguria (5 patients); mass-related symptoms (5 patients); and as an adjuvant to supportive medical management in preventing renal failure (9 patients). All but 2 patients exhibited bone marrow exacerbation. The results of treatment with radiotherapy are discussed. Total doses in the range of 600 to 1,200 rads are suggested. (auth)

5758 PATIENT EXPOSURES FROM FILM AND XERORADIOGRAPHIC MAMMOGRAPHIC TECHNIQUES. Rothenberg, L. N.; Kirch, R. L. A.; Snyder, R. E. (Memorial Hospital, New York). Radiology; 117: No. 3, 701-703(Dec 1975).

From 60th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL, USA (1 Dec 1974).

Radiation exposures of several mammographic imaging systems, including industrial film, xeroradiographic plates, the Du Pont Lo-Dose vacuum-cassette screen-film combination exposed with a molybdenum target tube, and xeroradiographic plates exposed with a tungsten target, were investigated with a thin-window ionization chamber and a range of exposures for different breast sizes was determined for each technique. The Lo-Dose system was found to provide high-quality diagnostic images with minimal patient exposure. (auth)

5759 SURFACE DOSE FROM MEGAVOLTAGE THERAPY MACHINES. Gagnon, W. F.; Grant, W. III. (Univ. of Texas, Houston). Radiology; 117: No. 3, 705-708(Dec 1975)

To determine the cause of increased skin reactions near the edges of the field the authors measured doses at and near the surface of the skin with an extrapolation chamber for the gamma-ray beam of an AECL Eldorado 8 ^{60}Co gamma irradiator and the x-ray beams of a Varian Clinac 4 linear accelerator, a Varian Clinac 6 linear accelerator, and an ARCO Mevatron 8 linear accelerator. Buildup curves were measured on each machine to locate the depth of the maximum dose (D/sub max/). The surface dose of the central axis was measured as a function of field size. Off-axis surface doses were measured on the Clinac 4 linear accelerator and on the Eldorado 8 ^{60}Co gamma therapy unit. No measurable increase in surface dose was found leading the authors to believe that the observed skin reaction in the axilla for the Clinac 4 linear accelerator is due to a combination of increased dose at D/sub max/ from the anterior mantle field and an increase in exit dose from the posterior mantle field when compared to similar treatments for ^{60}Co gamma. (auth)

Vertebrates

Refer also to abstracts 5684 and 5688.

5760 (COO-3017-24) LEUKEMOGENESIS BY LOW-LEVEL RADIATION. Warren, S.; Gates, O. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1975. 25p. (SM-202/218). Dep. NTIS $4.50.

Intermittent x-radiation administered in three *R* doses for ten successive weeks to RAP mice did not increase the incidence of leukemia. A total dose of 100 R (10 R weekly) significantly increased the level. A total dose of 300 R (30 R weekly) increased the incidence of leukemia only slightly but not significantly over that induced by the 100 R total dose. The two leukemogenic doses of x-radiation (100 and 300 R) yielded incidences of leukemia comparable to those following mean doses of perinatal gamma exposure at 200 and 1000 rads. However, continuous lifetime exposure of five successive generations to 30 rads was by far more effective than the higher doses of gamma or x-radiation. In these wide discrepancies between leukemogenic effects of equal low doses of gamma and x-radiation, there are two disparate factors; chronic versus intermittent exposure and the populations at risk; young adult mice versus mice exposed from conception to death. (auth)

5761 (ERDA-tr-51) RADIOBIOLOGY. Translation of Radiobiologiya; 15: No. 2, 171-328(1975). 181p. Dep. NTIS $7.60.

Separate abstracts were prepared for 40 of the 41 papers presented in this issue of the translation of Radiobiologiya. The other paper discussed the influence of bone marrow on the number of antibody-producers in a culture of cells from lymph nodes. (ERB)

For abstracts of individual papers see: 5684–5688, 5695, 5696, 5699–5702, 5731, 5732, 5736, 5762–5780, 5804, 5807–5810, 5815, and 5816.

5762 (ERDA-tr-51, pp 13-17) INFLUENCE OF X IRRADIATION ON THE DEVELOPMENT OF HYPERPOLARIZATION OF CELLS, THE CONTENT OF ADENINE NUCLEOTIDES, AND THE DISTRIBUTION OF SODIUM AND POTASSIUM IONS. Frol'kis, V. V. (Academy of Medical Sciences USSR, Kiev). 1975. Translated from Radiobiologiya; 15: No. 2, 181-184(1975).

In Radiobiology.

X irradiation prevents the development of hyperpolarization of muscle and liver cells, induced by hormones (estradiol dipropionate, deoxycorticosterone acetate, and insulin) and blood loss. X irradiation eliminates the redistribution of K^+ and Na^+ induced by hyperpolarizing factors and does not change the content of ATP, ADP, CP, and P/sub i/. It is assumed that the influence of x irradiation on the development of hyperpolarization and on the ionic shifts in this case is exerted through the system of protein biosynthesis. (tr-auth)

5763 (ERDA-tr-51, pp 18-21) REACTION OF THE ATPase ACTIVITY OF THE CELLULAR STRUCTURES OF THE LIVER TO THE ACTION OF DENSELY AND SPARSELY IONIZING RADIATIONS. Andrianov, V. M.; Chebotarev, E. E.; Kulyabko, P. N.; Roiter, I. A. (Academy of Sciences, Ukrainian SSR, Kiev). 1975. Translated from Radiobiologiya; 15: No. 2, 185-188(1975).

In Radiobiology.

Whole-body irradiation of animals with fast neutrons and x rays disrupts the ATPase activity in liver tissues. The difference in the action of these types of ionizing radiations lies in the fact that during the first hours after irradiation with fast neutrons, the ATPase activity is suppressed chiefly in the nuclei of the hepatocyte, and after x irradiation in the cytoplasm. (tr-auth)

5764 (ERDA-tr-51, pp 26-29) FACTORS CONTROLLING THE RECIRCULATION OF STEM CELLS. Communication 2. Influence of ACTH on the Migration of Hematogenic Stem Cells from a Shielded Portion of the Bone Marrow in Irradiated Mice. Bezin, G. I.; Khaitov, R. M.; Moroz, V. V.; Petrov, R. V.; Romashko, O. O. 1975. Translated from Radiobiologiya; 15: No. 2, 193-196(1975).

In Radiobiology.

A two-fold decrease in the yield of colonies in the spleen was detected in lethally irradiated (800 R) mice with partial shielding of the bone marrow, which received large doses of long-action ACTH twice after irradiation. The administration of ACTH after whole-body irradiation at a dose of 600 R had no influence on endogenous colony formation. The results obtained are interpreted as a suppression of the emigration of stem cells out of the protected bone marrow under the influence of a high level of corticosterone in the blood plasma, observed after the injection of ACTH. (tr-auth)

5765 (ERDA-tr-51, pp 30-35) DETERMINATION OF THE NUMBER AND RADIOSENSITIVITY OF BONE MARROW CELLS FORMING ERYTHROID, MYELOID, AND MEGAKARYOCYTIC TYPES OF COLONIES IN THE SPLEEN. Shvets, V. N.; Chertkov, K. S.; Seslavina, L. S. 1975. Translated from Radiobiologiya; 15: No. 2, 197-201(1975).

In Radiobiology.

Syngenic transplantation of intact or irradiated bone marrow cells increases the number of microcolonies 2 to 3-fold in comparison with macrocolonies. The number of macro- and microscopically detectable colonies is a linear function of the number of cells transplanted and an exponential function of the irradiation dose. The ratio and radiosensitivity of the bone marrow cells forming erythroid, myeloid, and megakaryocytic type colonies proved to be somewhat different. (tr-auth)

5766 (ERDA-tr-51, pp 36-40) SOME RESULTS OF A MATHEMATICAL MODEL STUDY OF THE DYNAMICS OF POST-RADIATION RECOVERY OF HEMOPOIETIC TISSUE. Monichev, A. Ya.; Gruzdev, G. P. (Inst. of Biophysics, Moscow). 1975. Translated from Radiobiologiya; 15: No. 2, 202-206(1975).

In Radiobiology.

A mathematical model is proposed for the recovery of hemopoietic tissue at the level of stem cells, considering their migration in the animal organism. The principles of the recovery of hemopoietic tissue in the case of various doses of total body irradiation, as well as nonuniform irradiation, were analyzed on the basis of the model. (tr-auth)

5767 (ERDA-tr-51, pp 46-51) INFLUENCE OF THE DOSE RATE OF THE GAMMA RAYS OF ^{60}Co ON THE COLONY-FORMING CELLS OF THE MOUSE BONE MARROW. Shvets, V. N. 1975. Translated from Radiobiologiya; 15: No. 2, 212-217(1975).

In Radiobiology.

In the case of irradiation of mice at dose rates from 300 R to 50 R/day, two fractions of CFU, differing in radiosensitivity, are detected in the bone marrow of the animals. In the case of irradiation at a dose rate of 300 R/min to 50 R/day, the fraction of radiosensitive cells is 80 to 100 percent. Their number decreases with decreasing dose rate. The values of ED_{10} and D_0 for the radiosensitive fraction of CFU proved similar and did not depend on the dose rate. The fraction of radioresistant cells increases with decreasing dose rate, comprising 1,4 to 20 percent. ED_{10} and D_0 for this fraction decreased several-fold. (tr-auth)

5768 (ERDA-tr-51, pp 68-72) RADIATION DAMAGE TO A TISSUE-EQUIVALENT MEDIUM ON ACCOUNT OF ELASTIC COLLISIONS IN IRRADIATION WITH PROTONS WITH INITIAL ENERGIES 0,2 TO 100 keV AND WITH 1 TO 1000 keV NEUTRONS. Naumov, V. A.; Rozin, S. G.; Troitskii, N. A.; Yaroshevich, A. A. (Academy of Sciences Belorussian SSR, Minsk). 1975. Translated from Radiobiologiya; 15: No. 2, 233-237(1975).

In Radiobiology.

The number of light and heavy atoms ejected during elastic collisions of protons with energies 0.2 to 100 KeV with biological tissue and in the case of irradiation with neutrons with initial energies from 1 to 1000 KeV was calculated. The calculations were performed according to a Monte Carlo method, simulating the processes of interaction of charged particles with the substance, on a system of Minsk-22 electronic computers. In view of the numerous approximations, the results are rough; nonetheless they can be used to interpret the primary lesions induced by the recoil protons. (tr-auth)

5769 (ERDA-tr-51, pp 73-77) TESTING OF THE ACTIVITY OF PLANT RADIOTOXINS AS ALLERGENS FOR SKIN TESTS IN IRRADIATED ANIMALS. Kuzin, A. M.; Klemparskaya, N. N.; Kryukova, L. M.; Isichenko, I. B.; Shikhodyrov, V. V. (Academy of Sciences USSR, Pushchino). 1975. Translated from Radiobiologiya; 15: No. 2, 238-243(1975).

In Radiobiology.

The development of processes of autosensitization in irradiated animals was studied by the method of the intracutaneous test–the labial reaction (LR). An investigation of the LR of normal and irradiated (700 R) mice to intracutaneous injection of preparations from plant tissue irradiated at a dose of 25 kR (RT) and nonirradiated (NRT) plant tissue was conducted. It was shown that irradiated animals differ sharply from nonirradiated animals in the LR when they are administered RT, NRT and distilled water also induce the investigated reaction, but to a substantially lesser degree. The dynamics of the reaction was followed at various time intervals after irradiation, according to various degrees of formation of the autoimmune response. (tr-auth)

5770 (ERDA-tr-51, pp 102-105) PHOSPHOROLYSIS AND DEOXYRIBOSYLTRANSFERASE REACTIONS OF THYMIDINE AND DEOXYURIDINE IN THE ORGANS OF IRRADIATED RATS. Mikhailov, V. F.; Mazurik, V. K.; Fedorova, T. A. 1975. Translated from Radiobiologiya; 15: No. 2, 266-268(1975).

In Radiobiology.

The purpose of this work was to study the intensity of the phosphorylitic cleavage of deoxyuridine and thymidine, as well as the formation of these deoxyribosides by deoxyribosyltransferase reactions in the liver and organs of hematogenesis of irradiated rats. The high activity of the enzymes studied, as well as the accumulation of free thymidine in the tissues in the decomposition of DNA after irradiation, permit us to assume that the postradiation increase in the content of deoxyuridine in the organism is partly due to its synthesis from thymidine and uracil. An increase in the summary content of thymidine and deoxyuridine in the irradiated organism is not associated with the inhibition of phosphorylase, since their activity in the organs was unchanged after irradiation. (ERB)

5771 (ERDA-tr-51, pp 120-123) CHANGES IN THE ACID RESISTANCE OF ERYTHROCYTES UNDER THE CHRONIC INFLUENCE OF FAST NEUTRONS ON THE ORGANISM. Beresnev, V. L.; Zhil'tsov, I. F. 1975. Translated from Radiobiologiya; 15: No. 2, 281-283(1975).

In Radiobiology.

The stability of erythrocytes to prolonged irradiation of the animal (rabbits and rats) with fast neutrons at low doses was investigated. The increase found in the resistance of the cells in rabbits after the cessation of irradiation was probably due to a stimulation of erythropoiesis, which is indicated, in particular, by a certain increase in the content of erythrocytes in the peripheral blood. An analogous relationship between the indices of the peripheral blood considered was also observed in experiments on rats. (ERB)

5772 (ERDA-tr-51, pp 130-133) PECULIARITIES OF THE RESTORATION OF BONE MARROW HEMATOGENESIS IN IRRADIATED MONKEYS. Novikova, M. I. (Academy of Medical Sciences USSR, Sukhumi). 1975. Translated from Radiobiologiya; 15: No. 2, 289-292(1975).

In Radiobiology.

The purpose of this work was to study the peculiarities of recovery and the periods of normalization of hemopoiesis in Macacus rhesus subjected to a single whole-body gamma irradiation at a dose of 560-640R. The data obtained are evidence that in monkeys injured by ionizing radiation, the repair processes in the organs of hematogenesis develop slowly over a long period of time. (ERB)

5773 (ERDA-tr-51, pp 134-136) DETERMINATION OF ROSETTE-FORMING LYMPHOID CELLS AFTER NONUNIFORM IRRADIATION OF MICE. Kozhinova, E. V. 1975. Translated from Radiobiologiya; 15: No. 2, 292-295(1975).

In Radiobiology.

The purpose of this work was to study the principles of the migration of rosette-forming cells (RFC) against a background of nonuniform irradiation in mice. The data obtained indicate that cells of the thymus gland and bone marrow, representing either RFC directly or their precursors, which then undergo differentiation, migrate into the spleen. The antigen-fixing ability of the lymphoid cells in the case of joint shielding of part of the bone marrow and the region of the thymus gland approaches the normal level, which is evidence of participation of the bone marrow and thymus cells in the maintenance of the population of RFC in the nonuniformly irradiated and intact organism. (ERB)

5774 (ERDA-tr-51, pp 141-144) INFLUENCE OF THE OXYGEN-VITAMIN COMPLEX ON THE GENERAL AND IMMUNOLOGICAL REACTIVITY OF THE IRRADIATED ORGANISM. Shvanskaya, N. L.; Baran, L. A. (Kiev Scientific Research Roentgenoradiological and Oncological Inst.). 1975. Translated from Radiobiologiya; 15: No. 2, 298-301(1975).

In Radiobiology.

The influence of the oxygen-vitamin complex (OVC) on the general, nonspecific immunological reactivity of the organism was studied using whole-body x-irradiated rats. It was found that the use of OVC improved the general and immunological reactivity in radiation sickness in rats. (ERB)

5775 (ERDA-tr-51, pp 145-147) ULTRASTRUCTURAL PECULIARITIES OF LESIONS IN THE HEPATOCYTES OF RATS IRRADIATED WITH X RAYS AND FAST NEUTRON. Andrianov, V. M.; Kulyabko, P. N.; Chebotarev, E. E. (Academy of Sciences Ukrainian SSR, Kiev). 1975. Translated from Radiobiologiya; 15: No. 2, 301-303(1975).

In Radiobiology.

Damages to the ultrastructure of liver cells of animals irradiated with fast neutrons and x rays in biologically equivalent doses were studied. The experiments were conducted on whole-body irradiated (fast neutrons or x rays) white rats. The results of the investigation show that there are not only quantitative, but also qualitative differences in the response of organisms to the action of densely and sparsely ionizing radiations. The data agree with previous conclusions that chiefly the structures of the cell nucleus are damaged under the action of densely ionizing radiation, while sparsely ionizing radiations damage primarily the cytoplasm. (ERB)

5776 (ERDA-tr-51, pp 148-150) EFFECTS OF LOCAL IRRADIATION OF A TUMOR ON THE LEVEL OF THIOLS IN THE MEMBRANE STRUCTURES OF THE LIVER. Glushchenko, N. N.; Danilov, V. S. (Moscow State Univ.). 1975. Translated from Radiobiologiya; 15: No. 2, 304-306(1975).

In Radiobiology.

The content of thiol groups in the organelles of the cells, as a result of the high differentiation of which unity and directedness of the biochemical reactions are ensured during the development of the tumor and the action of radiation therapy was studied. The data obtained are evidence of a substantial disruption of the content of thiols in the membrane structures of the tissue. The intensification of tumor growth found on the fourth day after a single irradiation caused a sharp decrease in the level of thiols in the investigated membrane structures. (ERB)

5777 (ERDA-tr-51, pp 151-154) DETERMINATION OF ^{3}H-MEXAMINE IN THE ORGANISM AND IN LIVER CELLS OF MICE. Pavlova, L. M.; Sverdlov, A. G.; Grachev, S. A.; Bagiyan, G. A. (Academy of Sciences, Leningrad). 1975. Translated from Radiobiologiya; 15: No. 2, 306-308(1975).

In Radiobiology.

The distribution of mexamine in the mouse, the penetration of the preparation into the cell, and its distribution within the cell were studied. The results of experiments studying the distribution of mexamine among the organs of mice showed that 20 min after intraperitoneal injection, the protector is accumulated primarily in the liver and kidneys. The negligible content of the preparation in the spleen may indicate a disruption of the blood supply of this organ, since when mice are given sulfur-containing radioprotectors, which do not exhibit a vasoconstrictive action, the sulfur content in the spleen far exceeds a uniform distribution (250 to 280 percent). The data that we obtained on the small content of mexamine in the mouse spleen agree with other data on the smaller sorption of neutral red in this organ after the introduction of mexamine as a result of spasm of the vessels that it induces. Noteworthy is the high content of tritium in the gonads of the mice 20 min after the introduction of the preparation. By this time, up to 214 percent of the label is accumulated in the testes, evidently belonging to the unchanged preparation, which may be of definite significance in the protection of the testes in these animals. Thus, the data cited are indirect evidence in support not only of vascular, but also of cellular mechanisms of the action of mexamine in the integral organism. (ERB)

5778 (ERDA-tr-51, pp 155-156) KINETICS OF THE IMMUNE RESPONSE IN NONUNIFORMLY IRRADIATED (SHIELDING OF THE THYMUS GLAND AND PART OF THE BONE MARROW) MICE OF DIFFERENT LINES. Batyrbekov, A. A. 1975. Translated from Radiobiologiya; 15: No. 2, 309-310(1975).

In Radiobiology.

An attempt was made to strengthen the immune response of nonuniformly irradiated mice with shielding of part of the bone marrow source of beta-lymphocytes by means of simultaneous protection of the thymus gland (source of T-lymphocytes). The interaction of cells of the bone marrow and thymus gland in the case of their joint shielding was manifested to different degrees depending on the genotype. It was concluded that the genetically determined differences between the mice of the CBA line (high reactivity) and the mice of the C57BL/6 line (low reactivity) are associated with cooperative interactions between the T and B lymphocytes, expressed to different degrees, upon which the

different intensity of the migration of B-lymphocytes from the bone marrow or T-lymphocytes from the thymus gland may be based. (ERB)

5779 (ERDA-tr-51, pp 157-158) INFLUENCE OF REVERSE ANAPHYLAXIS ON THE SURVIVAL OF IRRADIATED MICE. Ivanov, A. A.; Andrianova, I. E. 1975. Translated from Radiobiologiya; 15: No. 2, 311-312(1975).

In Radiobiology.

An analysis of the literature data on the clinical manifestation of anaphylaxis and the primary response to irradiation, as well as our immunological analysis of the primary response to irradiation, have made it possible to suggest a generality of the mechanisms of the development of these phenomena. It is known that decomplementing agents suppress the development of anaphylactic shock. On the basis of this, in the present work we made an attempt to change the levels of the primary response to irradiation and increase the survival of irradiated animals by lowering the level of complement in the serum, achievable by reverse anaphylaxis. Earlier therapeutic effect of a resolving injection of antigen in anaphylactic shock, performed immediately after irradiation, was established. However, sensitization before irradiation may change the reactivity of animals and their resistance to irradiation; therefore, in the work we used the method of reverse anaphylaxis, which does not require preliminary sensitization. It was found that an influence leading to a decrease in the level of complement without preliminary (before irradiation) change in the immunological status of the sensitization for the active development of anaphylaxis, increased the survival of irradiated animals. (ERB)

5780 (ERDA-tr-51, pp 161-164) DEPENDENCE OF THE CHANGE IN THE DYNAMICS OF THE WATER METABOLISM IN THE RABBIT ORGANISM ON THE DOSE OF EXTERNAL gamma RADIATION. Romanovskaya, L. L.; Bogdanov, K. M.; Filatov, P. P.; Kazanina, G. A. (Academy of Medical Sciences USSR, Obninsk). 1975. Translated from Radiobiologiya; 15: No. 2, 314-317(1975).

In Radiobiology.

A study and mathematical description of the dependence of the change in the dynamics of the water metabolism in rabbits on the dose of external gamma radiation was undertaken using tritiated water. In the work they detected and described the dependence of the half elimination constant of the isotope on the dose of irradiation, which is exponential. The quantitative ratios obtained, characterizing the degree of disruption of the dynamics of the water metabolism, expressed in terms of the ratio of the biological half-lives to the half-elimination constant, were obtained; in the comparative series control: 300 R:500 R:900 R they have values of 15:21:32:47, respectively. (ERB)

5781 DISRUPTION OF DEAMINATION OF SOME NITROGEN COMPOUNDS WITH RADIATION INJURY. Gorkin, V. Z.; Akopyan, Zh. I. Sovrem. Probl. Radiobiol.; 4: 164-190(1975). (In Russian)

An examination is made of the results of research on the molecular mechanisms of disruptions of the processes of metabolism of biogenic amines and other nitrogen compounds in radiation injury, as well as methods of actively influencing these processes. References 103. (Ref. Zh.)

5782 RADIATION DISRUPTIONS OF LIPID METABOLISM IN THE MEMBRANE FORMATIONS OF A CELL. Kolomiytseva, I. K.; Vasil'ev, A. V. Sovrem. Probl. Radiobiol.; 4: 149-163 (1975). (In Russian)

The following topics are covered: the specifics of lipid metabolism accompanying radiation injury; biosynthesis of phospholipids and cholesterol in the liver of irradiated rats; radiation disturbances of lipid metabolism in subcellular structures; exchange of phosphate and acyl groups of phospholipids; and principles governing transfer of phospholipids between the subcellular structures of liver cells of rats. References 82.

5783 METABOLIC FREE RADICALS IN THE TISSUES OF ANIMALS IN THE NORM AND DURING IRRADIATION. Kolomiytseva, I. K. Sovrem. Probl. Radiobiol.; 4: 250-260(1975). (In Russian)

An examination is made of the part played by water, oxygen, and x-ray exposure in the change of concentration and metabolism of free radicals in animal tissue, the participation of mitochondria in the formation and stabilization of the amount of free radicals in the cell in accordance with data of EPR spectroscopy. It is shown that there is a correlation between the activity of succinate dehydrogenase and the concentration of free radicals in the mitochondria of the liver of mammals in the norm and after irradiation. (Ref. Zh.)

5784 ELECTRON MICROSCOPIC STUDY OF SPONTANEOUS AND EXPERIMENTALLY INDUCED LEUKEMIA IN IRC MICE. Hiraki, S.; Ranadive, K. J.; Dmochowski, L. (Univ. of Texas System Cancer Center, Houston). Cancer Res.; 34: 474-483 (Mar 1974).

Spontaneous, serially transplanted, and experimentally induced leukemias of ICRC mice were studied by electron microscopy in an attempt to detect the presence of virus particles, if any, and to observe the influence of chemical and hormonal treatment on the presence of these virus particles. The first series of experiments included spontaneous, serially transplanted, and radiation-induced leukemia. The paucity of type C virus particles was quite conspicuous in spontaneous leukemia. Serially transplanted and radiation-accelerated leukemic lesions showed the presence of some type C and intracisternal type A particles. Found in two of these leukemic lesions (thymus and lymphosarcoma), in addition to type C virus particles, were budding and some mature type B virus particles, and numerous intracytoplasmic type A particles. "Viropexis" of type B virus particles has been observed in the lymphosarcoma and in a leukemic thymus gland. The second series of experiments included leukemia induced in ovariectomized ICRC mice with 20-methylcholanthrene (MCA), pituitary transplants, and ovarian hormones (estradiol and estradiol-progesterone). In ovariectomized ICRC mice, leukemic lesions induced by MCA or pituitary transplants, or by MCA and pituitary transplants, showed type C virus particles and, in most cases, intracisternal type A particles. In leukemia induced in ovariectomized ICRC mice by MCA and estradiol, numerous intracytoplasmic type A particles were observed by no type C virus particles were found. (auth)

5785 MICROSOMAL RAT LIVER β-GLUCURONIDASE: CHARACTERIZATION AND BEHAVIOR FOLLOWING X IRRADIATION. Durante, M.; Covi, A.; Barsanti, L. (CAMEN, Pisa, Italy). Ital. J. Biochem.; 23: No. 5, 292-305(1974).

Rat liver β-Glucuronidases from microsomal membranes and cisternae were purified and characterized. We compared some parameters, such as electrophoretic mobility, pH optima, heat inactivation, enzyme activity, and substrate affinity of the enzymes obtained from control and x-irradiated animals. (auth)

5786 DELAYED-TYPE HYPERSENSITIVITY IN THE MOUSE. II. Transfer by Thymus-Derived (T) Cells. Cooper, M. G. (Australian National Univ., Canberra). Scand. J. Immunol.; 1: 237-245(1972).

Delayed-type hypersensitivity (DTH) to Salmonella polymerized flagellin (POL) was transferred to normal and lethally irradiated CBA mice by POL-activated thymus-derived (T) cells or by lymphoid cells rich in T cells from POL-primed donors, but not by POL-activated bone marrow-derived (B) cells or by serum from POL-primed donors. It was therefore concluded that T cells play a key role in the initiation of DTH reactions. T cells activated by POL of one specificity were equally able to transfer DTH to POL of the same or of another specificity. DTH to haemocyanin (HCY) (Jasus lalandii) was transferred only by HCY-activated T cells. Two interpretations of these findings are discussed: (1) that T cells may be less restricted in specificity than B cells, and (2) that T cells recognize a common antigenic determinant (carrier determinant) on the polymerized flagellins of Salmonella spp. which is not recognized by B cells. (auth)

5787 ROLE OF ENDOGENOUS AMINES AND PEROXIDES IN THE MECHANISM OF THE PROTECTIVE ACTION OF RADIOPROTECTORS. Goncharenko, E. N.; Kudryashov, Yu. B. Sovrem. Probl. Radiobiol.; 4: 269-285(1975). (In Russian)

The mechanism of the protective action of radioprotectors (Rp) was investigated in rats. It is demonstrated that under the influence of various radioprotectors the concentration of endogenous amines (serotonin, dopamine, and histidine) in the tissues increases. The greatest increase in endogenous amine concentration with time corresponds to the period of maximum radioprotective action of Rp. The accumulation of biogenous amines in the tissues under prophylactic conditions is to a large degree connected with the formation of amines and to a lesser degree with the inhibition of their inactivation. It is considered necessary in searching for substances which afford chemical protection from radiation disease to seek those substances in the organism which lead to the accumulation of endogenous substances in them which possess radioprotective effects and lower the level of endogenous radiosensitizers. (Ref. Zh.)

5788 STUDIES OF ANTIBODY FORMATION IN VITRO AND IN LETHALLY IRRADIATED RECONSTITUTED MICE. Eidinger, D.; Pross, H. (Queen's Univ., Kingston, Ont.). Scand. J. Immunol.; 1: 193-203(1972).

The reconstitutive capacity of normal lymphoid cells versus cells obtained from mice immunized with keyhole limpet haemo-

cyanin was studied in lethally irradiated syngeneic recipients using horse erythrocytes as the test antigen. Evidence was obtained for an immune deficiency in the inoculum from immune donors, which was interpreted as evidence in favor of a cellular mechanism to account for antigen-induced suppression (antigenic competition). The unexpected inhibition of reconstitution with excessive numbers of normal spleen cells was duplicated in experiments using thymus or thymus-derived cells. Experiments assessing the effect of cortisone-resistant thymus cells on the response of normal spleen cells, in vivo and in vitro, gave evidence that a relative surplus of such thymus cells possess a capability for suppressing antibody formation. Since helper function by T cells is now well documented, this work is further indicative of the broader view, namely immuno-regulation by T cells. (auth)

5789 RADIATION EFFECTS ON THE KIDNEYS OF NORMAL AND UNINEPHROECTOMIZED RABBITS. Huth, F.; Heinzler, F.; Guenther, D. (Duesseldorf Univ.). Verh. Dtsch. Ges. Pathol.; 56: 467-472(1972). (In German)

Fourteen normal and 12 uninephrectomized rabbits have been exposed to radiation by betatron (17 MeV; 1000 to 6000 R; focal depth: 3 cm). The exposed kidneys have been investigated by light and electron microscopy, sometimes even histochemically after 2 hours up to 8 months. Tubular cell necroses as well as progressive cell proliferations of glomerular mesangium and the other renal interstitium are regarded as direct radiation effects. Vascular basal membranes are thickened. The sclerosing alterations are less developed in kidneys of rabbits with anticipated anterolateral uninephrectomy. The difference of these findings is discussed in correlation to the stronger developed radiation enteritis of the uninephrectomized animals. (auth)

5790 GRAFT-VERSUS-HOST REACTIONS IN MICE. III. Epithelioid and Multinucleated Giant Cells of Thymic Origin. Bennett, M.; Montes, M. (Roswell Park Memorial Inst., Buffalo). Am. J. Pathol.; 71: No. 1, 119-134(Apr 1973).

Thymus cells from C3H donor mice were infused into lethally irradiated (C3H x C57BL/10)F_1 hybrid mice. Light and electron microscopic examination of the lymphoid tissues of recipients revealed the presence of epithelioid and multinucleated giant cells in addition to lymphocytes and histiocytes. Serial transplantation of thymus-derived cells into irradiated F_1 hybrid mice resulted in a preponderance of epithelioid cells over lymphocytes. Epithelioid cells, as well as lymphocytes and histiocytes, incorporated ^{3}H-thymidine, indicating that they were actively proliferating. Following transplantation of CBA-T6T6 thymocytes into irradiated (C3H x C57BL/10)F_1 mice, karyotypic analysis of host lymphoid tissues indicated that all dividing cells were of donor origin. Whereas bone marrow is known to give rise to epithelioid cells in the absence of thymic influences, the thymus must also contain precursors of epithelioid cells. (auth)

5791 RESULTS OF SCALP EXAMINATION. Vogel, F. S.; Lloyd, B.; Cruty, M. R.; Benton, E. V. (Duke Univ., Durham, NC). Aviat., Space Environ. Med.; 46: 553-560(Apr 1975).

The scalps of the four pocket mice that were recovered alive from the Apollo XVII flight contained acute focal lesions in the epidermis and an inflammatory reaction in the subjacent dermis and subcutaneous tissue. Hair follicles were focally damaged in three of the four mice. There were 13 scalp lesions singled out in the four flight mice because of histological features that distinguished them from changes observed in the scalps of the control mice. There was only one possible coincidence between a lesion and the trajectory of a cosmic ray particle registered in a subscalp dosimeter. There is, however, a possibility that at least some lesions were produced by unregistered particles. (auth)

5792 AUTOMATED RECOGNITION OF IRRADIATED CHROMOSOME IMAGES. Aggarwal, R. K. Lafayette, IN; Purdue Univ. (1974). 120p. University Microfilms Order No. 75-17,145.

Thesis (Ph. D.).

The problem of monitoring health related radiation damage is an important one for future and a system to detect chromosomal aberrations associated with radiation is extremely useful for monitoring populations at risk. In general, the most useful indicator of radiation damage at cell level is the occurrence of ring, dicentric, fragment, and ring fragment chromosomes. The skeleton transformation is used for describing shapes of these chromosomes. A "Cutoff Level Independent Skeletonization" technique is proposed, discussed, and compared against Hilditch's and Montanari's techniques for obtaining a skeleton from a digitized grey level picture. An automated system using this approach for recognizing irradiated chromosomes is described in this dissertation. The test results of the system on 25 irradiated cells are included. The system requires 71.8 sec of CP time (CDC 6500) per cell and achieves about 94 percent accuracy of correct classification of chromosomes. A "concave-segment" method to detect touching and overlapping chromosomes is also proposed and discussed. The test results of this method on 10 cells are included. It achieves 96 percent accuracy in detecting such cases. A method is also outlined to separate touching chromosomes and a special case of overlapping chromosomes. (Diss. Abstr. Int., B)

5793 ORIGIN, MORPHOLOGIC, AND FUNCTIONAL CHARACTERISTICS OF A NEW LYMPHOID CELL TYPE IN IRRADIATED MOUSE BONE MARROW. Haot, J.; Betz, E. H.; Simar, L. J.; Revesz, L. (Univ., Leige). Acta Haematol.; 51: 170-178(1974).

After sublethal irradiation, an immature lymphoid cell type with characteristic ultrastructure was found in the bone marrow and thymus of adult mice of different strains. Normally this cell type has only been detected in the embryo or new-born. Grafting normal, adult bone marrow suppresses, while thymectomy enhances the proliferation of these cells in the irradiated organism. Immunologic and functional tests suggest that the cells have either an embryonic origin, or are derivatives of haemopoietic stem cells and function either as precursors for the immunocompetent B and T cells, or in an entirely different lymphoid system. (auth)

5794 ASSOCIATION OF VIRUS IN RADIATION AND CHEMICAL LEUKEMOGENESIS IN RATS AND MICE. Yokoro, K.; Imamura, N.; Kajihara, H.; Nakano, M.; Takizawa, S. (Hiroshima Univ.). Bibl. Haematol.; No. 39, 603-616(1973).

A comparative study of chemical and radiation leukemogenesis was carried out in mice and rats. The results obtained from this study indicated that there seems to be a common mechanism both chemical and radiation leukemogenesis in mice. In both instances, the direct inducer is Gross type virus; and carcinogenic chemicals or radiation merely provide a favorable condition for a sufficient interaction of the virus and its target cells, and the proliferation of antigenically altered leukemic cells most likely through their immuno-suppressive effect on the host. On the other hand, the mechanism involving leukemogenesis in rats appears to be different from that in mice. In rats, there has been no evidence for viral implication and the mechanism remains to be determined. (auth)

5795 HYPERACUTE REJECTION OF SKIN ALLOGRAFTS IN THE MOUSE. Gerlag, P. G. G.; Koene, R. A. P.; Hagemann, J. F. H. M.; Wijdeveld, P. G. A. B. (Univ. of Nijmegen, Netherlands). Transplantation; 20: No. 4, 308-313(Oct 1975).

The destructive action of alloantiserum and exogenous complement on ingrowing skin allografts was studied. B6AF1 recipients of a B10.D2 skin graft received a single intravenous injection of B6AF1 anti-B10.D2 serum (antiserum to H-2K.31) together with rabbit complement (RC) within the first 10 days after transplantation. Different models were used: recipients without immunosuppression, recipients treated with antilymphocyte serum, x-irradiation, or enhancing antibody. If the injection was given between day 5 and 10 after grafting, hyperacute rejection occurred in all cases. The rejection seemed to be most violent when the injection was given on days 7 or 8. Injections given on days 1, 2, or 3 after grafting could not induce hyperacute rejection, but resulted, on the contrary, in a prolongation of graft survival, probably due to immunological enhancement. Injections on day 4 produced patchy necrosis, but the grafts recovered and the residual tissue showed a prolonged survival. The results suggest that the presence of a functioning vascular network is a prerequisite for the occurrence of hyperacute rejection of skin allografts in the mouse. (auth)

5796 IMPAIRED GROWTH OF A RADIATION-INDUCED LYMPHOMA IN INTACT OR LETHALLY IRRADIATED ALLOGENEIC ATHYMIC (NUDE) MICE. Bonmassar, E.; Campanile, F.; Houchens, D.; Crino, A.; Goldin, A. (National Cancer Inst., Bethesda, MD). Transplantation; 20: No. 4, 343-346(Oct 1975).

Radioinduced lymphomas were maintained in mice by serial transplantation of neoplastic cells and mortality of mice was recorded for 60 days. Mice were x-irradiated at a dose rate of 137 R/min. Lethally irradiated mice were resistant to an incompatible lymphoma as determined by ^{125}I-IUdR uptake values of the spleen. The lack of influence of an immunodepressive factor and the observation that lethal irradiation did not abrogate the relative resistance to tumor challenge appeared to exclude the possibility that the reduced growth of the lymphoma in nude mice is the result of a conventional allograft reaction. (HLW)

5797 EFFECTS OF γ RAYS ON THE DEVELOPING EMBRYOS OF CALOTES VIRSICOLOR. Shaver, E. L. (Univ. of Poona). Experientia; 31: No. 10, 1213-1215(15 Oct 1975).

The γ-ray irradiation causes mortality, retardation in development and growth rate, haemorrhage, axial defects and unilateral microphthalmia. Histological examination of microphthalmic embryos revealed a partial division of the left optic cup and a "double lens." (auth)

5798 ULTRAVIOLET LIGHT-INDUCED MINIATURE END-PLATE POTENTIALS IN FROG NEUROMUSCULAR JUNCTION. Goto, J.; Kuroda, H. (Nagoya Univ., Showa, Japan). Experientia; 31: No. 10, 1178-1179(15 Oct 1975).

The discharge frequency of miniature end-plate potentials was increased by the uv-light application. This phenomenon can be attributed to the effect on the presynaptic terminal. (auth)

5799 MATURATION OF THE SEMINIFEROUS EPITHELIUM IN MICE AFTER IRRADIATION DURING FOETAL DEVELOPMENT. Rudnicki, T.; Trojczuk, D. Nukleonika; 20: No. 5, 499-503(1975). (In Russian)

The maturation of the seminiferous epithelium after irradiation with 50 rads of x-rays at 17th day of foetal development was investigated. There are relatively little quantitative changes in cell populations of cords and afterwards of tubules as far as 14th day of life. But the late lesions were distinct seen when the maturated testis is transformed into mature one. These lesions were manifested still at 60th day of life. (auth)

5800 EARLY AND LATE EFFECTS IN SEMINIFEROUS EPITHELIUM IN MICE AFTER FRACTIONATED IRRADIATION WITH 100 RADS. Rudnicki, T.; Kochmanska-Twardowska, A. Nukleonika; 20: No. 5, 491-498(1975). (In Russian)

Quantitative changes in 6 types of spermatogonia in mice as well as the influence of disturbances of spermatogenesis on maturation of spermatids after total single and fractionated irradiation with x-rays were estimated. The total dose 100 rads was fractionated into 2-9 split doses, administered in 24 resp. 96 hours. The above mentioned cell populations show different reactivity to radiation. The relative character of each testing of effectiveness of dose fractionation was shown. In general, the final biological effects of single fractionated exposure are approximately equal in spite of some differences in dynamics of injury. (auth)

5801 ULTRAVIOLET INJURY OF CONNECTIVE TISSUE. Sengupta, K. P.; Sanyal, S.; Biswas, S. K.; Pal, N. C. (Inst. of Post Graduate Medical Education and Research, Calcutta). Indian J. Exp. Biol.; 13: No. 4, 337-342(Jul 1975).

Changes induced by uv irradiation of rat skin could be divided morphologically into prenecrotic, necrotic and regenerating phases. During prenecrotic and necrotic phases, decrease in water content, collagenous protein, citrate buffer soluble fraction, elastin and total lipid and its fractions, and increase in non-collagenous protein nitrogen and fucoglycoprotein were observed. Increase in serum and urinary hydroxyproline and hexosamine, and serum sialic acid and fucose revealed the complicated nature of intrinsic changes occurring systemically. The study revealed that the ground substance was more easily affected while collagen, elastin and fat appeared to be more resistant to injury. This could be due to superficial action of radiation of short duration (30 min) on the dermal connective tissue. (auth)

5802 BIOLOGICHESKOE DEISTVIE PRODUKTOV YADERNOGO DELENIYA. (Biological Effects of Nuclear Fission Products). Nevstruevoi, M. A.; Tokina, I. B.; Shubika, V. M. (eds.). Moscow; Atomizdat (1975). 238p.

The biological effect of an unseparated mixture of nuclear fission products of different ages and the combined action of internal and external radiation on experimental animals is considered. The action on immunological reactions characterizing the state of nonspecific and specific immunity and autoallergic reactivity and on cytomorphological reactions of liver, spleen, lymph node, bone marrow, and intestinal epithelium cells is described. Problems of cell and tissue radiation sensitivity and remote sequelae are discussed. Recommendations are given on morphological indexes, from which it is possible to evaluate the activity of reticulo-endothelial and blood-vascular systems. The book is designed for a wide circle of specialists, doctors, and scientific workers in radiation biology, morphology, immunology, microbiology, virology, and radiation protection. 285 references. (tr-auth)

5803 INFLUENCE OF IONIZING RADIATION ON FETO-PLACENTAL GROWTH IN MICE. Philippe, J. V. Am. J. Obstet. Gynecol.; 123: No. 6, 640-645(15 Nov 1975).

From 14th annual meeting of the Teratology Society; Vancouver, B. C. (7 Jul 1974).

The effects of single doses of ^{60}Co whole-body irradiation were studied in about 600 inbred primiparous Swiss-Webster mice on gestational day 9, 10, 11, or 12. The embryos and their placentas were weighed from day 13 to 18. A reference model surveyed the response of the conceptus to varying doses. A significant reduction in the fetal wet weight was observed as follows: day 9, 150 to 175 R; day 10, 125 to 150 R; day 11, 75 to 175 R; day 12, 125 to 450 R. Beyond the upper-limit doses, a high mortality rate was detected, i.e., 64.5 percent on day 10 at 175 R and 63 percent on day 11 at 200 R. The rapid growth period of the placenta extended from day 13 to 15. By this latter stage it had practically reached its maximum development. The placental index decreased progressively from day 13 to 18; however, this index was higher than the control on day 12 in treated animals, while lower on day 9, 10, or 11. (auth)

Invertebrates

5804 (ERDA-tr-51, pp 127-129) ANALYSIS OF THE NATURE OF FLUCTUATIONS IN THE RADIORESISTANCE OF THE SEA URCHIN DURING EARLY EMBRYOGENESIS. Konstantinova, M. M.; Tarasenko, A. G.; Nekrasova, I. V.; Dontsova, G. V. (Academy of Sciences USSR, Moscow). 1975. Translated from Radiobiologiya; 15: No. 2, 286-288(1975). In Radiobiology.

An analysis of the relationship of the radiosensitivity of sea urchin eggs to the level of endogenous thiols in them in the course of the division of cleavage using modification of radiation damage was conducted. The radioprotective effect of various concentrations of MEA on the phases of mitosis differing most in their sensitivity to thiol content (metaphase and telephase) was also investigated. Also, the effectiveness of the radioprotective action of MEA on cells of other stages of the cell cycle and characterized by different contents of SH groups was determined. It was concluded that although thiols play only a secondary role in determining the nature of the radiosensitivity, in the case of the physiological change in the state of the cell (various stages of mitosis) they play a determining role. It was also shown that the radioresistance of the cells can be increased at both stages of mitosis with the aid of radioprotectors. (ERB)

5805 GENETIC DAMAGE AT SPECIFIC GENE LOCI IN DROSOPHILA WITH BETATRON X-RAYS. Alexander, M. L. (Southwest Texas State Univ., San Marcos). Genetics; 81: No. 3, 493-500(Nov 1975).

The mutation rate was determined for mature sperm at eight specific gene loci on the third chromosome of Drosophila melanogaster using the low ion density radiations of 22 MeV betatron x rays. A dose of 3000 rads of betatron x rays produced a mutation rate of 4.36×10^{-3} per rad/locus. Among the mutations observed, 66 percent were recessive lethals and 34 percent viable when homozygous. Only one of the 24 viable mutations was associated with a chromosome aberration. Among the 47 recessive lethals, no two-break aberrations were detected in 48.9 percent of the lethals, deletions were associated with 42.2 percent, inversions with 6.7 percent and translocations with 2.2 percent. When these genetic results are compared to those for 250 KV x rays, the mutation rate for betatron treatments was slightly lower (.76), the recessive lethal rate among induced mutations was higher, and the chromosome aberrations among lethal mutations were slightly lower than with 250 KV x rays. Although the two types of irradiations differ by an ion density of approximately ten, the amount and types of inheritable genetic damage induced by the two radiations in mature sperm were not significantly different. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract 5813.

5806 (ORNL-5000(Pt.2)) TABULATION OF DOSE EQUIVALENT PER MICROCURIE-DAY FOR SOURCE AND TARGET ORGANS OF AN ADULT FOR VARIOUS RADIONUCLIDES. Snyder, W. S.; Ford, M. R.; Warner, G. G.; Watson, S. B. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 441p. Dep. NTIS $10.60.

Data are tabulated on the radiation dose equivalent per microcurie-day for source and target organs of a human adult for 100 radionuclides. These are listed at the end of the volume. Included are several radionuclides where the parent has a daughter radionuclide of physical half-life less than five minutes. In such cases separate S tables are given for the parent and for the daughter as well as a composite table which contains S values for the parent plus S values for the daughter weighted according to the percent decay via the daughter. (CH)

Animals

Refer also to abstracts 5761 and 5816.

5807 (ERDA-tr-51, pp 41-45) CHANGE IN THE VALUES OF CERTAIN BIOCHEMICAL INDICES OF THE BLOOD AFTER THE INTRODUCTION OF RADIOACTIVE ISOTOPES. Zapol'skaya, N. A.; Fedorova, A. V. (Leningrad Scientific Research Inst. of Radiation Hygiene). 1975. Translated from Radiobiologiya; 15: No. 2, 207-211(1975).

In Radiobiology.

The change in certain biochemical indices arising in the blood during chronic peroral intake of strontium-90, cesium-137, and iodine-131, in amounts leading to the accumulation of commensurate doses in the corresponding critical organs for each isotope, was studied. (tr-auth)

5808 (ERDA-tr-51, pp 78-81) STUDY AND COMPARATIVE EVALUATION OF RADIATION LESIONS AND RECOVERY PROCESSES IN THE LARGE INTESTINE UNDER THE INFLUENCE OF RADIONUCLIDES OF THE RARE EARTH GROUP. Lavrent'ev, L. N. (Leningrad Scientific Research Inst. of Radiation Hygiene). 1975. Translated from Radiobiologiya; 15: No. 2, 244-246(1975).

In Radiobiology.

In the case of prolonged chronic irradiation of tissues of the large intestine of rats with various types of beta emitters, a definite relationship was noted between the tissue doses, the injurious effects, and the nature of the recovery. The indicated pattern was influenced by the dose rate. Among the factors maintaining the prolonged course of inflammatory and recovery processes, changes in the blood vessels and the introduction of microbial flora into the necrotized parts of the mucosa were detected. (tr-auth)

5809 (ERDA-tr-51, pp 91-95) SOME INDICES OF THE IMMUNOLOGIC REACTIVITY IN DOGS IN THE LONG-TERM PERIODS AFTER ADMINISTRATION OF POLONIUM. Shal'nova, G. A.; Kuz'mina, T. D.; Mikhailovich, S. M. 1975. Translated from Radiobiologiya; 15: No. 2, 256-259(1975).

In Radiobiology.

In dogs treated with polonium-210 (2.5 mu Ci/kg) and surviving as a result of treatment with oxathiol, seven years after the administration of the isotope a disturbance of the factors of natural immunity (quantitative and qualitative composition of the microflora and bactericidal properties of the skin and oral mucosa, phagocytic activity of the blood neutrophils) and the presence of an autoimmune state (a positive Hoigne reaction and reaction of leukocyte agglomeration) was detected. (tr-auth)

5810 (ERDA-tr-51, pp 159-160) STATE OF THE PROGENY OF FEMALE RATS TREATED WITH PLUTONIUM-239. Ovcharenko, E. P.; Nifatov, A. P. 1975. Translated from Radiobiologiya; 15: No. 2, 312-314(1975).

In Radiobiology.

The comprehensive development of the problem of the influence of ionizing radiation on the progeny requires the accumulation of knowledge of the influence of the most practically important radioactive isotopes. The successful work of domestic and foreign researchers along this line has as yet pertained only to a definite degree to the transuranium elements. Therefore, information on the substantial death of the progeny of animals treated with ^{239}Pu is stimulating a comprehensive study of the question. The sensitivity of the experimental baby rats of litter I at one month of age to intraperitoneal injection of ^{239}Pu citrate in amounts from 10 to 80 muCi/kg did not differ from the control. The response to the administration of subacute-toxic amounts of ^{239}Pu to the experimental progeny is analogous to that found earlier for ^{241}Am. The administration of the chronically effective amount of ^{239}Pu (0.004 muCi/g) to female rats had no influence on the weights, physical development, and peripheral blood of the baby rats and on their sensitivity to the supplementary administration of subacute-toxic amounts of ^{239}Pu. (ERB)

5811 RADIATION DAMAGE OF ^{32}P AND ADENOPITUITARY. Dev, P. K. (Univ. of Rajasthan, Jaipur, India). Curr. Sci. (India); 44: No. 19, 702(5 Oct 1975).

Phosphorus-32 was injected into young mice and they were killed at intervals. Histological examinations of the pituitary gland showed that the ventral margin consisted of more basophils than acidophils; this indicated that basophils were less radiosensitive than acidophils. Experiments on adult mice confirmed observations made on young mice. (HLW)

Nuclide Kinetics and Toxicology

Refer also to abstracts 5880 and 6899.

Man

5812 (HW-44341) DISTRIBUTION OF PLUTONIUM OBSERVED IN HUMAN BLOOD. Wilson, R. H. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 30 Jun 1956. 6p. Dep. NTIS $4.50.

The distribution and retention of plutonium in the blood system of nine individuals was studied following uptake by inhalation or through puncture. The results obtained indicate definitely that the blood content was much higher than would be predicted by analysis of urine samples obtained during the first few months after intake. They also indicated the possibility of material being slowly released to the blood from a source at the site of entry, to be subsequently deposited in the skeleton. (CH)

5813 RASPREDELENIE, KINETIKA OBMENA I BIOLOGICHESKOE DEISTVIE RADIOAKTIVNYKH IZOTOPOV IODA. (Distribution and Kinetic Exchange and Biological Actions of Radioactive Isotopes of Iodine). Il'ina, L. A.; Moskaleva, Yu. I. (eds.). Moscow; Izdatel'stvo Meditsina (1970). 240p.

The radioactive isotopes of iodine are the most dangerous, short-lived fission products of uranium. They can enter the human organism on contamination of the medium with industrial wastes and during nuclear testing. In addition the radioactive isotopes of iodine are widely used in clinical practice for diagnostic and therapeutic purposes. Hence a study of the exchange and biological effects of the iodine isotopes is of great importance. In spite of the significant number of previous studies both in the Soviet Union and in other countries, a number of problems associated with the exchange and biological effects of radioactive iodine have not yet been investigated. Hence the material in this collection is of significant interest. New data are presented on regularities in the behavior of I-131 in plants and large animals. Attention is devoted to materials on the exchange kinetics of radioactive, inhaled iodine, entrance of iodine through the skin, and to data on combined forms of contamination with iodine and other gamma emitters. Of practical importance are the studies on people with regard to problems of exchange and the prophylaxis of radiation damage to the thyroid gland. Attention is devoted to the biological effects of iodine on the cardio-vascular system, autoimmunity reactions, internal secretion glands, and also on the cancerous and noncancerous forms of remote effects, which develop on innoculation with radioactive iodine. The material in the book can be used in setting up standards for radioactive iodine. (SJR)

Animals

Refer also to abstracts 5586, 5878, and 5879.

5814 (CONF-751043-4) STUDIES DIRECTED TOWARD IMPROVING THE SPATIAL RESOLUTION OF THE DISTRIBUTION OF PLUTONIUM IN BONE. Auxier, J. A.; Beach, J. L.; Becker, K.; Gammage, R. D.; Henley, L. C.; Parkinson, W. W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 24p. Dep. NTIS $4.50.

From workshop on the biological effects and toxicity of Pu 239 and Ra 226; Sun Valley, Idaho, USA (6 Oct 1975).

Of several methods which have been discussed for the improvement of resolution in fission fragment track detectors for neutron-induced autoradiography, emphasis had been on the use of absorber layers inserted between the sample and the detector. Scanning electron microscopy was shown to be beneficial for viewing only the entrance holes of fission fragment tracks in the detector foil. The primary disadvantage of using thick absorbers lies in the factor of 50 to 100 percent loss in sensitivity over bare detectors. One promising solution to this problem is the use of glass detectors with high critical angles, no absorbers, and short etching times. Such detectors gave the best resolution of any system tested (+-2 mu), though they suffered at fluences greater than 10^{16} n/sub th/ cm^2 from high backgrounds as a result of their natural uranium content. Two samples of bone, each of 1 mg were dissolved in HNO_3 spiked with ^{244}Pu, and analyzed for total ^{239}Pu content in an isotopic abundance mass spectrometer. The ^{239}Pu concentration was 1 ppm by weight; bones with 10 ppm of ^{239}Pu are required, therefore, for neutron-induced autoradiography. Bones in suitable form for IMMA required only to be coated with a thin conductive coating of gold. In a fast scan mode, all elements were searched in 200 x 200 areas. Good quality micrographs were obtained showing Na, K, Ca, and P as major constituents with minor elements present, such as Cr and Fe. (CH)

5815 (ERDA-tr-51, pp 86-90) METABOLISM AND ACCELERATION OF THE ELIMINATION OF AMERICIUM-241 FROM THE ORGANISM AFTER INHALATION OF THE ISOTOPE. Il'in, L. A.; Popov, B. A.; Zalikin, G. A.; Skomorokhova, T. N.; Borisov, V. P.; Semenov, A. I. 1975. Translated from Radiobiologiya; 15: No. 2, 252-255(1975).

In Radiobiology.

In experiments on noninbred white rats with inhalation of

americium-241, it was shown that the basic organs of deposition of the radionuclide are the lungs–23.1 percent, the liver–6.3 percent, and the skeleton–2.9 percent (of the inhaled amount). The effectiveness of the treatment of animals with DTPA depends on the mode of administration. Administration of DTPA by inhalation (10 mu M) has the same effect as parenteral introduction of 100 mu M and per os administration of 500 mu M. (tr-auth)

5816 (ERDA-tr-51, pp 96-101) SOME DATA ON THE MICRODISTRIBUTION AND PATHOLOGICAL ANATOMY OF CURIUM-244. Rudnitskaya, E. I.; Moskalev, Yu. I. 1975. Translated from Radiobiologiya; 15: No. 2, 260-265(1975). In Radiobiology.

The work presents data on the microdistribution and pathological anatomical changes in the organs and tissues of rats subjected to a single intravenous injection of $CmCl_3$ (pH 3.0) up to 200 days before the beginning of the experiment. A dose of 0.2 to 0.1 mu Ci/g causes death of the experimental animals with a picture of acute radiation sickness, regardless of the period of death; some individuals survive up to 123 to 160 days after the beginning of the experiment at a dose of 0.1 mu Ci/g. Doses of 0.025, 0.01, 0.0025, and 0.001 mu Ci/g also produce specific changes, but less pronounced. In the bone, liver, kidneys, and cardiac muscle, by the end of the first day, aggregated particles of ^{244}Cm are detected. The most severe morphological changes develop in the hematogenic tissue, contained in the bony skeleton, and in the liver. (tr-auth)

5817 INTERPRETATION OF AN EXPERIMENTAL STUDY OF THE METABOLISM OF RADIOSTRONTIUM IN THE PLAICE (PLEURONECTES PLATESSA) USING FACTORIAL ANALYSIS. Amiard, J. C. (CEN, Fontenay-aux-Roses, France). Rev. Int. Oceanogr. Med.; 39-40: 177-212(1975). (In French)

The use of factorial analysis techniques (principal components and correspondences) allowed us to interpret several experiments on strontium metabolism in the plaice and its variations as a function of several biotic (age) and abiotic factors (temperature, salinity, sediment, calcium concentration of waters). Strontium uptake occurred mainly in soft tissues during the earliest contamination stage, whereas after the 12th day, it occurred mainly in the hard tissues. Colder temperature, the passage from brackish to sea-water, from gravel to sand, lowered strontium uptake. Within our experimental limits, calcium concentration had no effect on strontium uptake. (auth)

5818 TOXICOLOGY OF HIGH-FIRED BERYLLIUM OXIDE INHALED BY RODENTS. I. Metabolism and Early Effects. Sanders, C. L.; Cannon, W. C.; Powers, G. J.; Adee, R. R.; Meier, D. M. (Battelle Pacific Northwest Labs., Richland, WA). Arch. Environ. Health; 30: No. 11, 546-551(Nov 1975).

Several groups of male and female rats and hamsters were exposed by inhalation to an aerosol of BeO particles calcined at 1000 C. Initial alveolar depositions ranged from 12 mu g to 160 mu g Be. The alveolar retention half-life for BeO was approximately six months. Only the pulmonary lymph nodes accumulated detectable amounts of translocated BeO. Early alterations were seen in the alveolar macrophages, which were subsequently converted to histiocytic cells that accumulated in subpleural and peribronchiolar granulomatous lesions within eight months after the exposure. The alveolar clearance of a test aerosol, radioactive plutonium dioxide ($^{239}PuO_2$), was decreased to 60 percent of the normal rate when the radioactive material was given at 1, 30, or 60 days after exposure to BeO. These results demonstrate the important function of the alveolar macrophage in Be-induced granulomatous disease, as well as the rapid impairment of alveolar macrophage function by phagocytized BeO. (auth)

5819 RADIOISOTOPIC STUDIES OF HUMAN CHORIONIC GONADOTROPHIN IN THE MOUSE OVARY. Mizejewski, G. J. (Univ. of Michigan, Ann Arbor). Experientia; 31: No. 10, 1242-1244(15 Oct 1975).

The tissue localization of ^{125}I-HCG was studied in intact mice. ^{125}I-HCG concentrated in the thecal and interstitial tissues of the ovary. Differential uptake occurred in the corpora lutea which was dependent on the age and vascularization of the luteal body. (auth)

Plants

5820 (BNWL-SA-5389) FATE OF PLUTONIUM INTERCEPTED BY LEAF SURFACES: LEACHABILITY AND TRANSLOCATION TO SEED AND ROOT TISSUES. Cataldo, D. A.; Klepper, E. L.; Craig, D. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 17p. (CONF-751105-15; SM-199/60). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

A low windspeed plant exposure chamber was employed for the generation and deposition of particulate ^{238}Pu as nitrate, citrate, and oxide (fresh and aged) onto foliage of Phaseolus vulgaris. Physical deposition characteristics and particle sizing were routinely measured and deposition parameters calculated. At wind speeds of 0.42 cm sec^{-1}, deposition velocities for these compounds were of the order 10^{-3} cm sec^{-1} with deposition rates onto exposed foliage of 0.26 to 0.52 pg ^{238}Pu cm^{-2} sec^{-1}. The fate of surface deposited Pu compounds with respect to chemical modification and leachability was evaluated by leaching with synthetic rainwater and 0.1 percent HNO_3 solutions. Leaching of contaminated foliage with acidified solutions resulted in a 1-to-9 fold increase in Pu removal from foliar surfaces, depending upon chemical form, as compared to rainwater. Sequential leaching of foliage at 1, 7, 14, or 21 days after contamination indicated a reduced leachability of surface deposits with residence time on the leaf. The extent of leaching and concentration of soluble component was dependent on chemical form supplied (Pu-citrate greater than -nitrate greater than -aged oxide greater than -fresh oxide). The bioavailability of Pu as measured by translocation of foliarly deposited plutonium to root and seed tissue was markedly affected by the presence of a solution vector (i.e., simulated rainfall), and also the timing of its application. (auth)

New Tracer Techniques

Refer also to abstracts 5105 and 5814.

5821 (BNWL-SA-5576) INVESTIGATION OF THE ROLE OF ONCORNAVIRUS IN RADIATION-INDUCED OSTEOSARCOMAS. Frazier, M. E.; Park, J. F.; Jee, W. S. S.; Taylor, G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(11-1)-119. 15p. (CONF-751043-6). Dep. NTIS $4.50.

From workshop on the biological effects and toxicity of Pu 239 and Ra 226; Sun Valley, Idaho, USA (6 Oct 1975).

Viruses of the RNA tumor group are etiologic agents of spontaneously occurring neoplastic disease in a number of animal species. These oncornaviruses possess certain biochemical properties which permit them to be easily detected in infected cells, including RNA-instructed DNA polymerase (RIDP) and a closely associated 70S RNA genome in a cytoplasmic particulate fraction having a density of 1.15-1.20 g/ml. Tissues from three dogs with radiation-induced lung tumors and four dogs without tumors did not contain RIDP. However, RIDP was detected in materials prepared from five beagles with radiation-induced osteosarcomas. The presence of RIDP in these radiation-induced osteosarcomas can be considered indicative of retravirus or oncornavirus infection. (auth)

5822 (CONF-750124-) PROCEEDINGS OF FIFTH SYMPOSIUM ON SHARING OF COMPUTER PROGRAMS AND TECHNOLOGY IN NUCLEAR MEDICINE, SALT LAKE CITY, UTAH, JANUARY 15–16, 1975. McClain, W. J.; Maskewitz, B. F. (Comps.). (Oak Ridge National Lab., Tenn. (USA)). 1975. 290p. Dep. NTIS $7.60.

Separate abstracts were prepared on the 26 papers. All abstracts have been announced in Nuclear Science Abstracts and ERDA Research Abstracts. (CH)

For abstracts of individual papers see: 5823–5848.

5823 (CONF-750124-, pp 1-8) PSEUDOGRAY SHADE HARD-COPY DISPLAY OF NUCLEAR MEDICINE DATA USING A VERSATEC MATRIX 1100A PRINTER/PLOTTER. Goris, M. L.; Kriss, J. P. (Stanford Univ., CA). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Partly in an effort to reduce the operator time for each study recorded on the digital computer, and also in an attempt to produce hard copy displays with the inclusion of all relevant patient and study data, we have developed a set of algorithms allowing the introduction of patient and study data, the production of a pseudogray shade hard copy for scintigraphic images, and scaled plots for time functions using the Versatec electrostatic printer. This output device is interfaced with an HP 2100A computer (HP 5407A Digital Scintigraphic Data Analyzer), and driven under BCS. Programming is done in FORTRAN II, with a Fortran callable assembler subroutine for the binary output commands. No major developmental difficulties were met, and although the end result, for scintigraphic images, may not

represent the most satisfying solution on an aesthetic basis, in general this approach avoids the uncertainties resulting when the degree of photographic manipulation is not adequately recorded. (auth)

5824 (CONF-750124-, pp 9-13) COMPUTER CONTROLLED, INTENSITY MODULATE CRT DISPLAY OF DATA FROM SERIAL RADIONUCLIDE SCANS. Flowers, W. M. Jr.; Smith, R. O. (Univ. of Mississippi Medical Center, Jackson). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

A computer program has been developed which has the capability of intensity modulating each location of a cathode ray tube (CRT) x-y display. For such a program to process a given number of serial radionuclide scans the intensity or brightness of any given scan must have a constant relationship to the intensity and brightness of all other scans in the series. Though black, white, and ten shades of gray have been considered to be about maximum resolution for the human eye, 32 levels were chosen because the additional levels might provide a more pleasing display. Since the number of radiation events in any given pixel may far exceed 32, it is necessary to scale each matrix so that the range becomes 0 to 31. Uniformity is accomplished by computing a single scale factor for the entire series of scans. (auth)

5825 (CONF-750124-, pp 14-19) DISPLAY OF MEDICAL IMAGES. Pizer, S. M. (Univ. of North Carolina, Chapel Hill). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Despite the fact that controlled radionuclide studies have shown that computer processing improves the detectability of lesions, inadequate displays have produced scan images of less diagnostic usefulness than those produced by the primary device. This paper discusses an inexpensive display system that overcomes the inadequacies of most presently-used display devices. The system provides improved alphanumeric and graphics capabilities, as well as a hardware interpolation which interpolates on the fly, thus providing a gray scale image of high quality. (auth)

5826 (CONF-750124-, pp 20-28) DIRECT MEMORY ACCESS CRT DISPLAY CONTROLLER FOR DISPLAY OF RADIONUCLIDE IMAGES. Evans, P. L.; Kirch, D. L. (Denver VA Hospital). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

The need for high-fidelity computer output of radionuclide images is a long-standing problem in nuclear medicine computer applications. Three years ago we recognized the need for a device which would handle both static and dynamic images, permit interactive control of image display parameters, and operate with very little software overhead and CPU burden. We have built such a device and it has served reliably as the principal image output device for our dedicated PDP-12 computer system. It operates in 32 by 32 or 64 by 64 mode, has six bits of Z-axis resolution, handles areas-of-interest and cursor display functions, and permits an adjustable window to be used for selection of the Z-axis intensities to be displayed. This device is flicker-free and has been assembled using less than $1000.00 in parts (excluding the CRT), 300 man-hours of labor (including design time) and has operated with less than 1 percent down-time for 1½ years. This device has served an invaluable role in our investigative endeavors and is indispensable in assuring maximal information extraction from routine clinical data. A PDP-11 version of this device has also been constructed for display of 128 by 128 images. (auth)

5827 (CONF-750124-, pp 29-36) REPORT ON THE STATUS OF THYROID DATA BASES AT VANDERBILT. Patton, J. A.; Versage, P.; Blei, L.; Price, R.; Patton, D.; Brill, A. B. (Vanderbilt Univ. Medical Center, Nashville). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

As part of the thyroid task group effort, we are developing and maintaining two data bases related to our thyroid studies. The first of these files is a specialized data set involving the results of fluorescence imaging studies (iodine content, thyroid weight, and specific iodine content). Expected ranges have been determined for each of eight possible diagnoses with this data set. The second data set is more generalized and involves the collection of data from ten thyroid studies performed on selected patients in our thyroid clinic. This data set is in the early stages of review, however we have used it to establish expected values for the 20 minute Tc-99m uptake in the three clinical thyroid states (hyperthyroid, euthyroid, and hypothyroid). Also good correlations have been obtained between the Tc-99m uptake and the 4 and 24 hour radioiodine uptake with similar diagnostic information being obtained in most cases. (auth)

5828 (CONF-750124-, pp 37-47) COMPARISON OF HIGH TEMPORAL RESOLUTION LEFT VENTRICULAR VOLUME CURVES BEFORE AND AFTER MITRAL VALVE REPLACEMENT. Green, M. V.; Agress, H. Jr.; Brody, W. R.; Pearlman, A. S.; Douglas, M. A.; Ostrow, H. G.; Redwood, D. R.; Rtscoitz, S. B.; Bailey, J. J.; Johnston, G. S. (National Inst. of Health, Bethesda, MD). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

A patient with severe mitral insufficiency was studied preoperatively by conventional cardiac catheterization, including left ventricular contrast angiography, and also by ECG-gated scintigraphic angiocardiography. Following mitral valve replacement the patient was again studied both by cardiac catheterization and by the scintigraphic procedure. A comparison of preoperative left ventricular volume curves derived from a frame-by-frame analysis of the contrast angiogram, and from the scintigraphic procedure, showed good agreement. A major feature of both preoperative volume curves was a large, early diastolic filling rate. The postoperative scintigraphic volume curve exhibited a marked reduction in early filling rate and a much reduced end-diastolic volume. This study suggests that the scintigraphic procedure is capable of closely following diastolic and systolic changes in left ventricular volume. (auth)

5829 (CONF-750124-, pp 48-60) AUTOMATED SELECTION OF AREAS OF INTEREST IN DYNAMIC STUDIES AND CAMERA-CINEMATOGRAPHY OF THE HEART. Bitter, F.; Adam, W. E.; Kampmann, H.; Meyer, G.; Weller, R. (Ulm Univ., Ger.). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Progress is reported in heart investigations using the first transit principle and the steady-state procedure for radionuclide scanning. Progress in the first transit principle relies on automated selection of areas of interest. A procedure has been developed which automatically performs the evaluation of the areas corresponding to the right heart, the lungs, and the left heart. A different procedure has been built up for dynamic lung studies with Xe-133 (Radiospirometry), which principally can be applied to any other organ investigation. R-wave time averaged procedures of the heart in steady state can be performed in direct or indirect manner. A direct procedure is described that leads eventually to a cinematographic presentation of the heart kinetics on the computer display. The analysis yields an exact outline of heart ventricles and auricles as prerequisite for determination of ejection fractions and clinically relevant data of the heart function. (auth)

5830 (CONF-750124-, pp 61-65) SCAN SUBTRACTION TO SHOW INTERVENTION EFFECTS ON MYOCARDIAL PERFUSION. Smith, R. O.; Markov, A. K.; Flowers, W. M. Jr.; Lehan, P. H. (Univ. of Mississippi Medical Center, Jackson). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

When control radionuclide scans are separated by several days from experimental interventions and follow-up scanning, during

the interval, physiological changes may have occurred which will produce erroneous results in the later data. Currently, after the control scans are obtained, the desired intervention is produced, a second isotope bolus is given and additional scans are made. Usually, the counts in the last scan before the intervention are subtracted by a digital computer from the corresponding elements in the follow-up scans. The computer also displays the differences on an intensity modulated cathode-ray-tube. Because of the short time interval, any changes reflect the effects of the intervention alone and not other contributing factors which might have occurred during a longer intervening time. The data from mongrel dog ^{43}K heart scans suggest that combining scan subtraction with vasodilators could provide myocardial perfusion scanning information that heretofore has only been obtained by means of exercise or least squares regression analysis of serial scans made during a continuously decreasing isotope infusion. A significant advantage is that only the subtraction or regression analysis techniques provide a means of obtaining all the required data in a single scanning session even though subtraction does necessitate two bolus isotope injections. (auth)

5831 (CONF-750124-, pp 66-76) RAPID QUANTITATION OF LEFT TO RIGHT INTRACARDIAC SHUNTS BY USE OF A COMPUTER-INTERFACED GAMMA CAMERA. Seward, J. B.; Nolan, N. G.; Tancredi, R. G. (Mayo Clinic and Mayo Foundation, Rochester, MN). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Using a gamma camera interfaced to an on-line computer, a method is described for calculating the pulmonary to systemic flow ratio (Qp:Qs) following the intravenous injection of /sup 99m/Tc pertechnetate. Compared to cardiac catheterization, this technique is more rapid, less expensive and less traumatic and is as accurate in estimating the Qp:Qs. Seventeen adult patients with intracardiac shunts ranging from a Qp:Qs of 1.1 to 4.6 were correctly diagnosed and their shunts accurately quantitated by this method. Eight control subjects and six patients with clinically suspected intracardiac shunts were correctly diagnosed as having no shunt. (auth)

5832 (CONF-750124-, pp 77-88) COMPUTER-ASSISTED COMPUTATION OF INFARCT SIZE IN EXPERIMENTAL ANIMALS USING /sup 99m/TECHNETIUM PHOSPHATE SCINTIGRAMS. Stokely, E. M.; Lewis, S. E.; Buja, L. M.; Parkey, R. W.; Bonte, F. J.; Willerson, J. T. (Univ. of Texas Health Science Center, Dallas). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Three methods were investigated for predicting myocardial infarction size. /sup 99m/Tc stannous pyrophosphate scintigrams were obtained in six mongrel dogs 48 hours after coronary occlusion produced by ligating the left anterior descending coronary artery. Computer-aided processing of the images was used to calculate infarct projected area utilizing image processing and a Golay transform algorithm for detecting boundaries. The results suggest that infarct areas measured from anterior and left anterior oblique scintigrams can be used to calculate infarct weight using a linear relationship between scintigram infarct area and morphological infarct weight. Linear regression methods were used to determine the best linear relationship between the two sets of data. (auth)

5833 (CONF-750124-, pp 115-126) MEASUREMENT AND COMPARISON OF LEFT VENTRICULAR EJECTION FRACTION UTILIZING FIRST TRANSIT AND GATED SCINTIANGIOGRAPHY. Fletcher, J. W.; Herbig, F. K.; Daly, J. L.; Walter, K. E. (St. Louis Univ. School of Medicine). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Paired serial radionuclide scans were used for determinations of left ventricular ejection fraction (LVEF) in open chest dogs with constant cardiac output and varying ventricular rates following the left atrial injection of 99m-Tc human serum albumin. Values of LVEF obtained by first transit (high frequency) data analysis and ECG-gated scintiphotography were obtained over a wide range of ventricular rate and stroke volume. The results of this study show no significant difference in LVEF as determined by both of these methods of data acquisition and analysis and demonstrate the feasibility of rapid serial determination of LVEF by radioisotope techniques. (auth)

5834 (CONF-750124-, pp 127-137) APPLICATION OF A COMPUTERIZED IMAGE-INTENSIFIER RADIONUCLIDE IMAGING SYSTEM TO THE STUDY OF REGIONAL LEFT VENTRICULAR DYSFUNCTION. Kirch, D. L.; Steele, P. P.; LeFree, M. T.; Evans, P. L.; Stern, D. M. (Denver VA Hospital). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

The spatial and temporal operating characteristics of an image intensifier camera (IIC) have been measured and compared with those of an Anger camera (AC) for performing high count-rate dynamic studies of the heart. This study shows the AC has slightly better spatial resolution at count-rate below 40 Kcps but the IIC has better count-rate linearity (within 1 percent up to 600 Kcps) and improved detection efficiency. These properties make the IIC the instrument of choice in performing radionuclide angiocardiographic (RA) studies of the left heart. We have developed two techniques for demonstrating regional ventricular dysfunction using the computerized data from the IIC. These two techniques are termed the silhouette difference image (SDI) and the regional ventricular function image (RVF). Because these functional images combine two single 50 millisecond frames of data, the higher sensitivity and count-rate linearity of the IIC system is essential for performing these studies. (auth)

5835 (CONF-750124-, pp 138-154) UPDATE OF THE COMPUTER ANALYSIS OF CEPHALOANGIOSCINTIGRAPHY DATA. McLaughlin, W. T.; Price, D. D.; Butler, T.; Scheibe, P. O. (Santa Clara Valley Medical Center, San Jose, CA). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

In an effort to reduce the variability and increase the accuracy of the qualitative data obtained from the gamma scintillation camera, a minicomputer was used to process information obtained during the dynamic perfusion of the 99m technetium injected intravenously into patients referred for routine brain scintigraphy (brain scan). The paired bylateral regions of interest are selected over the carotid, middle and anterior cerebral arteries. Time function curves are generated for each region of interest and analyzed for the injection to arrival time, arterial phase and venous phase. Ratios of the smallest over the largest of the total count in the paired time segments are calculated for each of the regions of interest. A total of 263 cases have been studied. The 2 standard deviation ranges for the right to left ratios have been calculated for the group of 81 normal patients. The 2 standard deviation ranges for the circulation times in the 3 regions of interest have been calculated in the injection to arrival, arterial and venous phases in a group of 59 patients. The 2 standard deviation range for the right to left variation in the time of arrival, peak time and venous plateau has also been calculated. This data is presented, 1 normal and 1 abnormal case are used to illustrate the use of the technique clinically. The preliminary work validates the work of other investigators and suggests that this is a clinically useful procedure and a positive aid to diagnosis. Based on this initial work, further refinement of the technique is currently being undertaken in an effort to automate the procedure and make it more feasible to clinical nuclear medicine. (auth)

5836 (CONF-750124-, pp 155-160) XENON VENTILATION-PERFUSION LUNG SCINTIGRAPHY IMMEDIATELY FOLLOWING TECHNETIUM MICROSPHERE SCANNING: A COMPUTER-ASSISTED BACKGROUND SUBTRACTION TECHNIQUE. Nolan, N. G. (Mayo Clinic and Mayo Foundation, Rochester, MN). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

The conventional /sup 99m/Tc-albumin capillary blockade type of radionuclide lung scan suffers from a lack of sensitivity in

identifying small perfusion defects and from an inability to distinguish between the various causes of perfusion defect. This paper presents a simple computer-assisted technique which allows a ^{133}Xe ventilation-perfusion (V:Q) study to be performed immediately after the /sup 99m/Tc-albumin microsphere scans with the gamma camera optimally positioned over any defect that is seen. Crossover from the /sup 99m/Tc into the ^{133}Xe window is subtracted from the xenon study by the computer. This procedure allows advantage to be taken of a unique character of the acute pulmonary embolus, namely an elevation of the V:Q ratio in the affected area of lung. In this way, the specificity of the lung scan can be increased for pulmonary embolism. (auth)

5837 (CONF-750124-, pp 161-171) SIMPLE FUNCTIONAL IMAGE OF LUNG VENTILATION: THE MEAN TRANSIT TIME. Alpert, N. M.; Correia, J. A.; McKusick, K. A.; Shea, W.; Brownell, G. L.; Potsaid, M. S. (Massachusetts General Hospital, Boston). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

The mean transit time ($\bar{t}$) computed from Xe-133 washout measurements provides an estimate of ventilation from which a functional image of the lung can be generated. The computation can be done faster than that of any previously discussed method and it can be easily implemented on most available nuclear medicine computer systems. Functional images of ventilation computed from this method were used in the evaluation of over 60 adult patients referred for standard perfusion lung scans because of the possibility of pulmonary embolism. Since the functional image utilizes all of the data collected during washout, its statistical quality is superior to that of individual washout images obtained with sequential imaging techniques. It is our impression that this rapid, simple-to-derive functional image of ventilation provides information not apparent on standard sequential images taken during washout. (auth)

5838 (CONF-750124-, pp 172-179) RADIONUCLIDIC RENAL IMAGING AND COMPUTERS. Bradley-Moore, P. R. (The Mount Sinai Hospital, New York). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Progress is reported in the application of computers to the problem of radionuclidic imaging of the kidneys. Advances can particularly be expected with the advent of high useful flux agents allowing statistically more reliable curves or images from subdivisions of the whole kidney, with the imaging process itself progressively being improved by increase in resolution and speed of Auger cameras. Results are reviewed from studies of regional kidney function using /sup 99m/Tc and ^{131}I-labeled compounds as tracers. (CH)

5839 (CONF-750124-, pp 180-194) APPLICATION OF COMPUTER-GENERATED FUNCTIONAL (PARAMETRIC) MAPS IN RADIONUCLIDE RENOGRAPHY. Agress, H. Jr.; Levenson, S. M.; Gelfand, M. J.; Green, M. V.; Bailey, J. J.; Johnston, G. S. (National Inst. of Health, Bethesda, MD). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

A functional (parametric) map is a single visual display of regional dynamic phenomena which facilitates interpretation of the nature of focal abnormalities in renal function. Methods for producing several kinds of functional maps based on computer calculations of radionuclide scan data are briefly described. Three abnormal cases are presented to illustrate the use of functional maps to separate focal lesions and to specify the dynamic nature of the abnormalities in a way which is difficult to achieve with conventional sequential renal scans and renograms alone. (auth)

5840 (CONF-750124-, pp 195-208) DEDICATED COMPUTER ANALYSIS OF THE RADIOIODINE RENOGRAM. Bronstein, R. M.; George, D. L.; Parker, J. A.; Rose, J. G. (Medical Coll. of Pennsylvania, Philadelphia). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

One of the problems with renogram quantification is the estimate of the contribution to the kidney counts by extra-renal activity. Britton and Brown have proposed a blood background subtraction method using a three probe system. Esser, et al. have applied this method to a scintillation camera-dedicated computer system. The work reported here is a further extension of this method. Hardware consists of the Gamma-11 nuclear medicine computer manufactured by Digital Equipment Corporation. Analysis is through a combination of the Gamma-11 software and a user written program in FOCAL. The entire study consists of four imaging sequences: a ^{197}Hg static, a ^{131}IHSA image for background subtraction, the ^{131}I-Hippuran renogram, and a /sup 99m/Tc-DTPA flow study. Time required for analysis is 15 to 20 minutes, including a three minute computer program run. (auth)

5841 (CONF-750124-, pp 209-217) COMPUTERIZED TECHNIQUE FOR EVALUATING RENAL TRANSPLANT FUNCTION. Shames, D. M.; Farmer, R. E. L.; Wright, R. R.; Rollo, F. D.; Swann, S. J.; Salvatierra, O. Jr. (Univ. of California, San Francisco). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

This investigation was undertaken to improve the assessment of renal transplant function in the early post-operative period when the usual measures of renal function afford little useful information. A simplified mathematical model of I-131 hippurate transport allows separation of renal uptake and excretion. Uptake (U) is defined as the fraction of I-131 hippurate in the plasma picked up by the kidney per minute, and excretion (E), the fraction of I-131 hippurate in the kidney excreted into the bladder per minute. Scintillation camera data from the region of the renal allograft are framed at 4/min by a computer system for up to 30 minutes post injection. After regions of interest are flagged over the kidney, bladder and background regions, the activity-time curves are analyzed, and values for U and E are output in a report updated through punched paper tape for any values from previous studies. The entire analysis of a patient study requires about 5 minutes of technologist time. Over 150 studies on 24 patients have been analyzed using the above technique. In the immediate post-operative state when anuria or severe oliguria is often present, sequential estimation of U was found to be a sensitive measure of renal transplant viability. In the period beyond one week reductions in U and E appeared to be sensitive measures of rejection, while increases in U and E heralded amelioration of the rejection episode. Changes in U and E appeared to be more sensitive measures of changes in renal function than routine qualitative scintiphotographic analysis. This technique has proven useful in following the renal function status of the kidney transplant recipient through acute tubular necrosis and rejection episodes and has been a significant adjunct to routine scintigraphy. (auth)

5842 (CONF-750124-, pp 218-225) INTERACTIVE COMPUTER SYSTEM FOR ANALYSIS OF DYNAMIC RENAL STUDIES. Cahill, P. T.; Ornstein, E. (Polytechnic Inst. of New York). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

An interactive computer system is described for a small minicomputer to be used in the evaluation of radionuclide scintiscanning studies of renal transplants and other dynamic kidney function studies. The package consists of programs for data acquisition, analysis, and report generation. As an added feature, the program dissociates the kidney view into total kidney, cortical, and medullar components. (auth)

5843 (CONF-750124-, pp 226-228) LABORATORY MANAGEMENT FUNCTIONS OF COMPUTERS IN NUCLEAR MEDICINE. Cradduck, T. T. (Univ. of Toronto). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer pro-

grams and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

The remarkable growth of the use of digital computers in nuclear medicine has resulted in the application of these devices in many routine clinical areas. The basic needs within these clinics of data collection, storage, analysis, and display have been fulfilled to a great extent. Additional applications, including radiotherapy, in vitro studies, and computer-aided instruction are being explored. Laboratory data management is the one new area common to all clinics. The importance and the required capabilities of laboratory data management systems are discussed. (auth)

5844 (CONF-750124-, pp 229-232) LEVEL OF CONFIDENCE IN NUCLEAR MEDICINE. Wenzel, W. W.; Kenney, G. N.; Avery, P. A. (Presbyterian Medical Center, Denver). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

In a private hospital nuclear imaging laboratory, the digital computer can add additional dimensions to the level of confidence of studies by providing additional information of dependable quality. Several factors, however, must be taken into account when one is considering the purchase of a computer for use in an active clinic. A time-shared computer system which is always available to physicians for analysis of studies, while simultaneously permitting data acquisition, processing, and program development, is discussed. (auth)

5845 (CONF-750124-, pp 233-240) IMPLEMENTATION OF A NUCLEAR MEDICINE NETWORK. Herbig, F. K.; Fletcher, J. W.; Daly, J. L. (St. Louis Univ. School of Medicine). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

A nuclear medicine information network is described which links three Veterans Administration Hospitals in rural Missouri and Illinois to the nuclear medicine service of the John Cochran Hospital in St. Louis, Missouri. By utilizing computer acquisition of pre-defined studies and synchronous telephone transmission of the acquired images to the central site, analysis of both static and dynamic studies is available to the remote hospitals without a nuclear medicine specialist in residence. (auth)

5846 (CONF-750124-, pp 241-250) ANALYTICAL TECHNIQUES FOR IMAGE SUPERPOSITION. Price, R. R.; Lindstrom, D. P.; Hillis, S.; Friesinger, G. C.; Brill, A. B. (Vanderbilt Univ. Medical Center, Nashville). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Analytical techniques for superimposing images of the same organ made at different times are described. The images may be either from the same or different instruments with different magnifications, rotations and distortions. Examples of superimposed images presented include: scanner images superimposed with scintillation camera images; and digital contrast arteriograms superimposed with camera images. Other applications of the techniques are suggested. (auth)

5847 (CONF-750124-, pp 251-261) COMPUTER TECHNIQUE FOR EVALUATING COLLIMATOR PERFORMANCE. Rollo, F. D. (Univ. of California, San Francisco). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

A computer program has been developed to theoretically evaluate the overall performance of collimators used with radioisotope scanners and gamma cameras. The first step of the program involves the determination of the line spread function (LSF) and geometrical efficiency from the fundamental parameters of the collimator being evaluated. The working equations can be applied to any plane of interest. The resulting LSF is applied to subroutine computer programs which compute corresponding modulation transfer function and contrast efficiency functions. The latter function is then combined with appropriate geometrical efficiency data to determine the performance index function. The overall computer program allows one to predict from the physical parameters of the collimator alone how well the collimator will reproduce various sized spherical voids of activity in the image plane. The collimator performance program can be used to compare the performance of various collimator types, to study the effects of source depth on collimator performance, and to assist in the design of collimators. The theory of the collimator performance equation is discussed, a comparison between the experimental and theoretical LSF values is made, and examples of the application of the technique are presented. (auth)

5848 (CONF-750124-, pp 263-284) IN VITRO TEST PROGRAMMING AT VANDERBILT. Erickson, J. J.; Versage, P. M.; Brill, A. B. (Vanderbilt Hospital, Nashville). 1975.

From 5th symposium on sharing of computer programs and technology in nuclear medicine; Salt Lake City, Utah, USA (15 Jan 1975).

In proceedings of fifth symposium on sharing of computer programs and technology in nuclear medicine. (Oak Ridge National Lab., Tenn. (USA)).

Demands being placed upon the medical community from several sources have initiated renewed interest in and immediate requirements for standardized nomenclature and terminology for use in medical reporting systems. These problems and their solutions provided the central focus of the Fourth Annual Conference of the Society of Nuclear Medicine. General sessions and workshops highlighted the demands being placed on medicine as well as some steps that have been taken to meet these demands. Representatives of twelve medical societies and academies met as an Ad Hoc Committee during the conference to review the needs and to consider steps necessary to develop a standardized computer-supported reporting system that would: bridge the growing gap between existing formal knowledge and bedside decisions; permit an organized presentation of clinical signal data; provide scientific definitions and current research findings to enable a clinician to retrieve scientific facts pertinent to his case; and provide the mechanism necessary for uniform peer review with sufficient feedback to upgrade medical case. This paper contains a report on the Fourth Annual Conference of Computer Medicine including some facts about this organization, some opinions, a brief review of presentations made concerning Standardized Languages, and a report on the Ad Hoc Committee meetings. (auth)

5849 (LA-UR-75-1983) HIGH-LEVEL ^{13}C-ENRICHMENT OF RANDOM AND SYNCHRONOUS POPULATIONS OF CHLAMYDOMONAS REINHARDII. Price, R. L.; Crissman, H. A.; Martin, J. C.; Kollman, V. H. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 38p. (CONF-751027-6). Dep. NTIS $4.75.

From 2nd international conference on stable isotopes; Oak Brook, Illinois, USA (20 Oct 1975).

The alga Chlamydomonas reinhardii was grown in suspension culture at high levels of ^{13}C-enrichment (98 mol percent) both in synchronous and random populations for the purpose of investigating possible macro- and ultrastructural changes in the cell as induced by essentially total carbon replacement. The algae, grown in spinner flasks, were analyzed using a newly developed multiparameter flow-system technique applied to characterizing various algal genera. The versatility of this technique provides for measuring and processing several cell characteristics simultaneously and separating cells according to selected combinations of parameters. In these studies, cell volume (by Coulter aperture) and DNA and chlorophyll content were determined simultaneously. Cell ultrastructure was examined at various levels of isotope enrichment and time periods by electron microscopy. The data presented for synchronous growth of this organism demonstrate the absence of biological effects (considering the parameters measured) due to the almost total replacement of cellular ^{12}C with ^{13}C. Interpretational problems encountered when looking for biological effects on random populations are discussed. (auth)

5850 SENSITIVE AND PRECISE RADIOIMMUNOASSAY FOR HUMAN THYROID-STIMULATING HORMONE. Pekary, A. E.; Hershman, J. M.; Parlow, A. F. (Univ. of California, Los Angeles). J. Clin. Endocrinol. Metab.; 41: No. 4, 676-684 (Oct 1975).

A high-sensitivity radioimmunoassay for human thyroid-stimulating hormone (hTSH) has been developed utilizing a highly specific rabbit antibody (developed by AFP) to hTSH with an affinity constant of $4.4 \times 10^{11} M^{-1}$. Optimal conditions which minimized both ^{125}I-hTSH radiation damage and ^{125}I dissociation included storage at –60 C in 0.25 percent albumin. Repetitive freezing and thawing did not cause loss of structural integrity or of full immunochemical reactivity of ^{125}I-hTSH. Effects of human and calf sera on the precipitation of first antibody-bound

^{125}I-hTSH by second antibody have been tabulated; the addition of TSH-free human serum to the standard curve is necessary to compensate for the serum effect. The minimum detectable amount of TSH in the new assay at a 1:1,000,000 final dilution of the hTSH antibody is 0.02 mu U/tube. The mean normal hTSH value of 1.5 +- 1.0 mu U/ml (mean +- SD) fell within the central one-third of the logit (B/B_0) plot where antigen concentrations are measured with highest precision. This assay gives good precision and reproducibility of measurements throughout the normal range of serum TSH concentrations. (auth)

5851 KINETICS AND INTERCONVERSION OF PREDNISOLONE AND PEDNISONE STUDIED WITH NEW RADIOIMMUNOASSAYS. Meikle, A. W.; Weed, J. A.; Tyler, F. H. (Univ. of Utah, Salt Lake City). J. Clin. Endocrinol. Metab.; 41: No. 4, 717-721(Oct 1975).

To determine the kinetics of metabolism and interconversion of prednisolone and prednisone, the plasma levels of these synthetic glucocorticoids were measured by new radioimmunoassays (RIA) after intravenous (iv) or oral administration to normal humans. Following the iv injection of prednisolone phosphate in 8 normal subjects, the mean half-time of prednisolone was 240 +- 20 min (mean +- SE) and the metabolic clearance rate was 82 +- 7.2 $^1/_{24}$ h/m^2. Of 10 mg of prednisone given orally to 5 normal subjects, 69 +- 5 percent was absorbed and converted to peripheral plasma prednisolone within 8 h. The data indicate that prednisone is extensively metabolized to prednisolone before it clears the splanchnic circulation and the formation of prednisone by oxidation of the 11-hydroxyl group of prednisolone appears to occur mainly in peripheral tissues. (auth)

5852 COMPARATIVE ASSESSMENT OF DIRECT AND INDIRECT METHODS OF DETERMINING INDICES OF FREE THYROXIN WITH THE HELP OF RADIOISOTOPE METHOD IN VITRO. Zamoskovnaya, V. A.; Zubovskii, G. A.; Frenkel, V. Kh. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Med. Radiol.; 20: No. 10, 8-13(Oct 1975). (In Russian)

The results of determination of the free thyroxin index (CT-4) and coefficient (KET) in healthy persons and patients with different diseases of the thyroid gland are compared. Observations of 195 patients age 18 to 70 years were made. The control group comprised 74 persons, in the rest different thyroid gland diseases were observed. In all the patients the index and coefficient of free thyroxin were determined. In healthy persons and patients with marked disorders of the thyroid gland function there is a distinct correlation between two ways of determining free thyroxin. In obliterated forms of thyroid pathology the number of differences between the CT-4 and KET indices is rather great. In view of the fact that KET is a direct way of determining free thyroxin and CT-4 is an indirect one (the latter is a derivative of two definitions—thyroxinbinding capability of globulins and total thyroxin and depends upon the changes of these indices) the discrepances of CT-4 and KET indices can be explained by the increase of the total quantity of thyroxinbinding globulin and increase of spatial distribution of general thyroxin in it. (auth)

5853 DETERMINATION OF BINDING CAPABILITY OF TRANSCORTIN BY RADIOISOTOPE AND FLUOROMETRIC METHODS. Slavnov, V. N.; Valueva, G. V.; Yakovlev, A. A.; Bezverkhaya, T. P. (Kiev Scientific-Research Inst. of Endocrinology and Exchange Matter). Med. Radiol.; 20: No. 10, 50-52(Oct 1975). (In Russian)

The method of determination of binding capability of transcortin with the use of labelled C^{14} hydrocortison and its comparison with a fluorometric method, without introducing labelled steroid into the system is described. Determination of binding ability of transcortin by the gel-filtration method with labelled hydrocortison and fluorometric method give identical results. The radioisotope method makes it possible to simultaneously determine the binding capability of transcortin, concentrations of binding and free fractions of hydrocortison, having conducted gel-filtration only once. When using the method of gel-filter with subsequent fluorometry without a label it is necessary to determine separately the binding capability of transcortin and concentrations of binding and free hydrocortison. (auth)

5854 PEDIATRIC ASPECTS OF NUCLEAR MEDICINE. Treves, S. (Harvard Medical School, Boston). Postgrad. Med.; 57: No. 3, 125-132(Mar 1975).

During the last few years, the number, variety, and complexity of nuclear medical examinations that can be performed in children have increased impressively, due partly to recent accomplishments in radiopharmaceutical development and the availability of gamma scintillation cameras and computer systems for acquisition, storage, and analysis of data. The reduction in radiation exposure with the new radiopharmaceuticals has helped to expand the scope of nuclear medical examinations in children to include not only the study or evaluation of suspected malignant disease but also the evaluation of nonmalignant disease and organ function in a number of body systems. Specific applications of nuclear medical techniques in children are discussed, with relation to the brain and cerebrospinal fluid, thyroid, lungs, heart and great vessels, liver and spleen, kidneys and bladder, and bone. (auth)

5855 NEWER DIAGNOSTIC TESTS IN THORACIC SURGERY. Skinner, D. B. (Johns Hopkins Univ., Baltimore). Ann. Thorac. Surg.; 15: No. 1, 94-101(Jan 1973).

Of the new diagnostic techniques introduced into thoracic surgery during the past decade, mediastinoscopy, azygography, ventilation and perfusion scans to evaluate emphysema and pulmonary function, flexible fiber optic esophagoscopy and bronchoscopy, and esophageal function tests have all proved valuable in clinical practice. Bronchial arteriography, tantalum dust bronchography, and scanning in pulmonary carcinoma promise to be of clinical value in the future but remain experimental at present. (auth)

5856 RADIOIMMUNOASSAY OF GROUP I PEPSINOGENS IN SERUM. Samiloff, I. M.; Liebman, W. M. (Harbor General Hospital, Torrance, CA). Gastroenterology; 66: No. 4, 494-502 (Apr 1974).

A radioimmunoassay for the group I pepsinogens (PG I) in human serum has been developed. The standard PG I was isolated from human urine, and when labeled with ^{125}I, was shown to be immunochemically homogeneous by radioimmunoelectrophoresis and radioimmunoprecipitation. The antiserum was obtained from rabbits immunized with partially purified PG I. Standard PG I and serum give parallel inhibition curves against the labeled antigen. The sensitivity of the assay is in the order of 2 ng per ml of serum. The reproducibility of the determinations was demonstrated. PG I in serum is stable when stored at -20^{0}C for at least 7 months. The mean (+-SD) serum PG I levels in 69 healthy control subjects and in 71 hospitalized control patients were 102.7 +- 32.5 and 96.2 +- 41.9 ng per ml, respectively. In 14 patients with pernicious anemia and in 12 patients with total gastrectomy, mean serum PG I levels were 10.2 +- 6.4 and 3.8 +- 2.9 ng per ml, respectively. In 5 patients with Zollinger-Ellison syndrome, the mean level was 456.1 +- 187.3 ng per ml. (auth)

5857 LOCALIZATION DIAGNOSTIC METHODS OF NUCLEAR MEDICINE IN DISEASES OF THE OSTEOARTICULAR SYSTEM. Makalova, I. I.; Makal, F. Bratisl. Lek. Listy; 62: No. 4, 430-439 (Oct 1974). (In Czech)

The authors present a description of methods in nuclear medicine for diagnosis of focal affections of the osteoarticular system, using bone seeking radiopharmaceuticals and radioactive substances for the detection of loci with increased blood flow. These methods have been used in diagnosing tumorous and not tumorous diseases of the osteoarticular system. Based on results of selected cases, the authors discuss the possibilities and clinical significance of these forms of diagnostics. (auth)

5858 SPECIFICITY OF ANTISERA TO ESTRONE DETERMINED BY DIFFERENT RADIOIMMUNOASSAY METHODS. Exley, D.; Choo, Q. L. (Univ. of London). J. Steroid Biochem.; 5: No. 5, 497-500(Aug 1974).

The specificity of an antisera to estrone which was raised with estrone-6-(O-carboxymethyl) oxime bovine serum albumin conjugate has been tested using different radioimmunoassay methods. Cross reactivity tests were made using (i) the liquid phase radioimmunoassay technique involving dextran coated charcoal, (ii) the double antibody precipitation technique, (iii) the solid phase method using polystyrene tubes, and (iv) the solid phase procedure using Enzacryl AA. The specificity of the estrone antisera to the various steroids tested, assessed as percentage cross reaction against estrone, was found to vary when determined by different radioimmunoassay methods. The results suggest that a choice of radioimmunoassay technique may be made such that a particular method would enable higher specificity to be obtained towards certain cross reacting steroids. (auth)

5859 COMPUTER PROGRAM FOR THE DETERMINATION OF CEREBRAL BLOOD FLOW USING THE ^{85}Kr OR ^{133}Xe INTRA-ARTERIAL INJECTION METHOD. de Valois, J. C.; Smith, J.; Peperkamp, J. P. C. (Central Inst. for Brain Research, Amsterdam). Int. J. Bio.-Med. Comput.; 1: 49-60(Jan 1970).

A computer program written in Fortran IV is described, which is used to determine cerebral blood flow in the rabbit under various experimental conditions. Data are obtained by the measurement of isotopes using Kr-85 and Xe-133 injected directly into the internal carotid artery. (auth)

5860 BLUNT SPLENIC INJURIES. Mlcoch, R. Rozhl. Chir.; 53: No. 8, 525-528(Aug 1974). (In Czech)

The author discusses diagnostic possibilities of blunt injuries of the spleen which develop mainly during traffic injuries and

which are frequently associated with a more or less serious associated injury which may distract attention from the injury of the spleen and frequently decide on the fate and survival of the patient. The author draws attention to advantages of diagnostic peritoneal lavage by means of a dialization cannula and to diagnostic possibility of scintigraphy and arteriography, and when there is suspicion of renal damage, also to differential diagnosis by excretory urography. In rare instances probatory laparotomy is justified. From material of the Third Surgical Clinic and the Traumatological Research Institute blunt injuries of the spleen covering a period of ten years (1961–1970) were analyzed. (auth)

5861 DIAGNOSTIC POSSIBILITIES OF SCINTIPNEUMOGRAPHY IN REVEALING CONGENITAL PULMONARY DEFECTS IN CHILDREN. Sergeev, V. M.; Semenikhin, B. F.; Kal'din, M. I.; Katkovskii, G. B. Grud. Khir.; No. 4, 60-65(1974). (In Russian)

On the basis of analysis of the data obtained during scanning of the lungs in 45 children with congenital defects of this organ, aged from 4 to 15 years, the authors have arrived at the conclusion that it is expedient to use this method in a complex examination of such patients. This method allows one to reveal anatomo-functional disorders in the lungs more completely and to orientate the surgeon in determining indications to an intervention and the choice of a volume of resection. Specific features for conducting such investigations in children are described. (auth)

5862 PLASMA 17 alpha HYDROXYPROGESTERONE: AN IMPROVED RADIOASSAY METHOD. Tan, S. Y.; Murphy, B.E.P. (Yale Univ., New Haven). Steroids; 25: No. 2, 283-284(Feb 1975).

Most of the published methods for the measurement of 17 alpha hydroxyprogesterone (17-OHP) in human plasma are relatively time-consuming and insensitive. This paper describes a rapid (8 hours) and sensitive (capable of detecting 50 pg 17-OHP) competitive-protein-binding radioassay method using dog transcortin and Sephadex LH-20, and is modified after the original report of Murphy. (auth)

5863 BRAIN SCANNING. Mandrillo, M. P. (Univ. of Virginia, Charlottesville). Nurs. Clin. North Am.; 9: No. 4, 633-640(Dec 1974).

In this paper we will consider the brain scan and the knowledge the nurse will need to understand in order to give intelligent care to the patient having this neurodiagnostic study. We will include indications for the study, radiopharmaceuticals, physiology, scanning instruments, prior preparation, procedure, brain scan interpretation, and the implications for nursing management. (auth)

5864 QUINOLINE ANALOG LABELED WITH ^{123}I IN MELANOMA DETECTION. Packer, S.; Redvanly, C.; Lambrecht, R. M.; Wolf, A. P.; Atkins, H. L. (Brookhaven National Lab., Upton, NY). Arch. Ophthalmol. (Chicago); 94: 504-508(Jul 1975).

Using the Greene melanoma in the hamster (Syrian Golden), the radiopharmaceutical, ^{123}I-4(3-dimethylaminopropylamino)-7-Iodoquinoline, was tested for its ability to localize melanoma. This quinoline analog has been described for use in the detection of melanoma, but this is the first report, to our knowledge, of its being used with an ^{123}I label. Hamsters with either skin or eye melanomas were studied. Both melanomas could be seen with a gamma camera at three hours after injection. In vitro analysis confirmed the tumor specificity. Thus, it appears that this preclinical trial of a new radiopharmaceutical justifies clinical testing to determine its value in the localization of melanomas of the eyes and skin of humans. (auth)

5865 RADIOPERTECHNETATE FLOW STUDY: A VALUABLE ADJUNCT TO BRAIN SCANNING IN THE DIFFERENTIAL DIAGNOSIS OF CEREBELLO-PONTINE ANGLE TUMORS. Lamourex, J.; Bertrand, R. A.; Vezina, J. L. (Univ. of Montreal, Quebec). Laryngoscope; 83: 488-501

From meeting of the eastern section of the American Laryngological, Rhinological, and Otological Society, Inc.; New Haven, CT (4 Jan 1973).

Twenty-seven surgically proven acoustic neuromas were studied preoperatively with conventional brain scanning. Nine lesions were not diagnosed. Lesions less than 2.0 cm in diameter were not visualized (five patients). Lesions larger than 3.0 cm were all detected (15 patients). Lesions ranging in size from 2.0 to 3.0 cm were detected half of the time (six patients, seven lesions). Fourteen/sup 99m/Tc-pertechnetate flow studies were performed in 10 patients with acoustic neuromas. All were negative. A case of meningioma in the cerebello-potine angle and a case of arteriovenous malformation in the posterior fossa were visualized on conventional scan. The flow studies were positive and demonstrated patterns suggestive of the nature of the lesions. Flow study appears a valuable adjunct to brain scanning in the differential diagnosis of cerebello-pontine angle tumors. (auth)

5866 RAPID, SENSITIVE TEST FOR THE DETECTION OF ANTIBODIES TO DNA. Lewis, R. M.; Stollar, B. D.; Goldberg, E. B. (Tufts Univ., Boston). J. Immunol. Methods; 3: 365-373(Dec 1973).

A simple rapid binding assay capable of detecting antibodies to native DNA and heat denatured DNA is described. The relative sensitivity of the test has been studied and its specificity for immunologic diseases such as systemic lupus erythematosus in man, dogs, and mice is under investigation. (auth)

5867 RADIOIMMUNOASSAY METHODS FOR CARCINOEMBRYONIC ANTIGEN. Searle, F.; Lovesey, A. C.; Roberts, B. A.; Rogers, G. T.; Bagshawe, K. D. (Charing Cross Hospital, London). J. Immunol. Methods; 4: 113-125(Mar 1974).

A comparison of three radioimmunoassay methods for measuring the concentration of carcinoembryonic antigen in plasma is presented. Experimental details are outlined for a slight modification of the zirconyl phosphate gel assay and for a coated tube sandwich assay and a rabbit anti-CEA: guinea-pig anti-rabbit double antibody system. The resulting assay profiles are discussed with reference to their potential in clinical practice. (auth)

5868 QUANTITATIVE ESTIMATION OF AORTIC REGURGITATION BY ANALOG COMPUTER ANALYSIS OF RADIOCARDIOGRAM. Motohara, S.; Saito, M.; Hirakawa, A.; Ogino, K.; Takayasu, M.; Kuwahara, M. (Kyoto Univ.). Jap. Circ. J. (Engl. Ed.); 38: 169-180(Mar 1974).

A new method for the quantitative estimation of aortic regurgitation is reported in this paper. A mathematical model of the transport process of a radioisotope in a circulatory system with aortic regurgitation is developed and a simulation circuit of the transport process using analog computer is given. On the mathematical model, the regurgitation at the aortic valve is expressed as a back flow from the aorta with a transport delay equivalent to one cardiac cycle. The rate of regurgitant flow, as given by the ratio of regurgitant flow to the total outflow from the left heart, is determined after curve fitting between an actual radiocardiogram and a theoretical one produced by the simulation circuit for a moderate or large regurgitation, in cases where a definite change appears on the radiocardiogram. It is difficult to determine the rate of regurgitant flow for a small regurgitation of less than 30%. As a result of the simulation study of many radiocardiograms with aortic regurgitation, the following is made clear: (1) Rates of regurgitant flow obtained by the simulation are well correlated to those measured by left ventricular angiography; (2) A linear relationship exists between the computed mean left heart volume and the mean left ventricular volume by angiography; (3) In 31 radiocardiograms with isolated aortic regurgitation, the computed mean left heart volume increases linearly in proportion to the regurgitant volume per beat; (4) Pulmonary blood volume shows a slight but significant increase and it does not show any correlation with the grade of regurgitation; (5) Mean right heart volume does not increase and the ratio of mean right heart volume to mean left heart volume is inversely correlated with the rate of regurgitant flow. (auth)

5869 EFFECT OF DIAPHYSEAL SURGERY ON RADIOACTIVITY IN THE ZONE OF GROWTH OF LONG BONES. Kery, L.; Lenart, G.; Szasz, I. (Semmelweis Medical Univ., Budapest). Acta Chir. Acad. Sci. Hung.; 13: No. 3, 259-267(1972).

After labelling the long bones of growing rabbits with ^{85}Sr, radioactivity in the diaphysis has been compared with that in the zone of growth. Activity in the zone of growth was found to exceed that in the diaphysis. Surgical management of the diaphysis involving periosteal damage increased specific activity in the zone of growth. (auth)

5870 DIURNAL RHYTHMS IN TISSUE RADIOACTIVITY UPTAKE AFTER ^{3}H-ESTRADIOL AND ^{3}H-TESTOSTERONE ADMINISTRATION TO CASTRATED RATS. Nagle, C. A.; Cardinali, D. P.; Rosner, J. M. (Univ. El Salvador, San Miguel). Steroids Lipids Res.; 5: No. 2, 107-112(1974).

In order to examine the diurnal variations in tissue radioactivity uptake after ^{3}H-estradiol administration to ovariectomized rats or ^{3}H-testosterone administration to orchidectomized rats, animals receiving a pulse injection of the hormone at 2.00, 6.00, 14.00, and 20.00 h were killed 75 min later. In ^{3}H-estradiol-injected rats, significant diurnal variations in radioactivity uptake by the uterus (maxima at 6.00 h), the neurohypophysis (maxima at 20.00 h), and the hypothalamus (minima at 2.00 h) were observed. Tissue uptake of radioactivity after ^{3}H-estradiol administration remained relatively constant regardless of time of day in the adenohypophysis, the pineal organ, the parietal cerebral cortex, and the tibial muscle. In males administered with ^{3}H-testosterone, the prostate, adenohypophysis, pineal organ, and skeletic muscle attained maximum radioactivity uptake at 6.00 h.

Two maxima were observed in the uptake of radioactivity by the neurohypophysis, i.e. at 20.00 and 6.00 h. Changes observed in the cerebral cortex, retina, and hypothalamus were not significant. (auth)

5871 USE OF RADIOACTIVE XENON IN DIAGNOSTIC PROCEDURES FOR PULMONARY DISEASE. Milic-Emili, J. (McGill Univ., Montreal). Plucne Boles. Tuberk.; 26: No. 1, 3-6(1974). (In Slovak).

The use of radioactive xenon in pneumonology for the research as well as for the routine purposes is discussed. The importance of the tests for the early detection of obstruction in the peripheral airways is pointed out since the chronic nonspecific lung disease has become one of the greatest medical problems in the world. Bolus method with radioactive xenon for the measurement of closing volume has proved to be a simple, quick, and sensitive test which is very convenient for the investigations of great extent. (auth)

5872 ^{67}Ga RADIONUCLIDE IMAGING IN BURKITT'S LYMPHOMA. Richman, S. D.; Appelbaum, F.; Levenson, S. M.; Johnston, G. S.; Ziegler, J. L. (National Inst. of Health, Bethesda, MD). Radiology; 117: No. 3, 639-645 (Dec 1975).

Whole-body ^{67}Ga imaging was evaluated as a diagnostic tool for 14 patients with Burkitt's lymphoma, and a dramatic gallium affinity for the tumor was demonstrated. The gallium image is recommended as a staging procedure and as an effective test for determining the therapeutic response. (auth)

5873 DETERMINATION OF MICROSOMAL CHOLESTEROL BY AN ISOTOPE DERIVATIVE METHOD. Nicolau, G.; Shefer, S.; Mosbach, E. H. (Public Health Research Inst. New York). Anal. Biochem.; 68: No. 1, 255-259(Sep 1975).

A micromethod has been developed for the quantitative determination of unesterified or total cholesterol in liver microsomes. The method, sensitive to 0.1 nmole of cholesterol, is based on the conversion of cholesterol into its acetate by use of ^{3}H-labeled acetic anhydride of known specific radioactivity. For the determination of unesterified cholesterol, liver microsomal suspensions were extracted with methylene chloride–ethanol; for the determination of total cholesterol the microsomal suspensions were hydrolyzed and extracted with n-hexane. The lipid extract was reacted with [^{3}H] acetic anhydride in pyridine, the [^{3}H] acetoxycholesterol was separated by tlc and assayed by scintillation counting. (auth)

5874 RADIOIMMUNOASSAYS FOR LG CLASSES G, A, M, D, AND E IN SPINAL FLUIDS: NORMAL VALUES OF DIFFERENT AGE GROUPS. Nerenberg, S. T.; Prasad, R. (Univ. of Illinois, Chicago). J. Lab. Clin. Med.; 86: No. 5, 887-898(Nov 1975).

Radioimmunoassay procedures of sufficient sensitivity (IgG, 0.5 mu g per 100 mu l; IgA, 25.0 ng. per 100 mu l; IgM, 10.0 ng. per 100 mu l; IgD, 0.5 U. per 100 mu l; and IgE, 1.0 U. per 100 mu l) were developed to detect and quantitate all 5 immunoglobulin classes in the cerebrospinal fluid on small aliquots (1 mL) of unconcentrated cerebrospinal fluid. All 5 immunoglobulin classes were routinely detected in normal individuals for the first time, the levels varying with different age groups for IgG and A but not for the remaining immunoglobulin classes. Race and sex had no effect. Standardization of techniques and establishment of normal values for different age groups sets the stage for determination of immunoglobulin changes related to central nervous system disease. (auth)

5875 RECENT ADVANCES IN NUCLEAR CARDIOLOGY. Shames, D. M. (Univ. of California, Berkeley). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 51(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5876 USEFULNESS OF LIVER SCAN FOR THE DIAGNOSIS OF AMEBIC ABSCESS OF THE LIVER IN PEDIATRY. Ramirez, E. A. (INAM, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 51-52(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5877 RECENT DEVELOPMENTS IN X-RAY FLUORESCENCE ANALYSIS USING SEMICONDUCTOR DETECTORS. Jaklevic, J. M. (Univ. of California, Berkeley). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 62(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

5878 ^{67}Ga CITRATE DISTRIBUTION FOLLOWING WHOLE-BODY IRRADIATION OR CHEMOTHERAPY. Fletcher, J. W.; Herbig, F. K.; Donati, R. M. (St. Louis Veterans Administration Hospital). Radiology; 117: No. 3, 709-712(Dec 1975).

Whole-body retention, organ distribution, excretion, and serum binding of ^{67}Ga were evaluated in rats under normal conditions and following whole-body gamma irradiation or chemotherapy using vincristine sulfate or mechlorethamine. The results suggest that both irradiation and chemotherapy lead to reduced whole-body retention of injected radiogallium, explained in part by an alteration in the serum binding of gallium. Recognition of these findings should be considered in interpreting decreased tumor concentration of gallium in patients following radiotherapy or chemotherapy. (auth)

5879 MYOCARDIAL MAPPING TECHNIQUES AND THE EVALUATION OF NEW /sup 113m/In-LABELED POLYMETHYLENEPHOSPHONATES FOR IMAGING MYOCARDIAL INFARCT. Dewanjee, M. K.; Kahn, P. C. (Tufts Medical School and New England Medical Center, Boston). Radiology; 117: No. 3, 723-726(Dec 1975).

The localization of /sup 113m/In-ethylenediamine tetraethylenephosphonate and /sup 113m/In-diethylenetriamine pentamethylenephosphonate in myocardial infarct induced in rabbits by coronary artery ligation was investigated. Double labeling of the same tissue with ^{45}Ca ion was used as an index of tissue degeneration. The radioactivity ratio (40 to 50:1) of infarcted to normal myocardium was obtained 1.5 hours after injection and 2.5 hours after infarct. For the ^{45}Ca-labeled phosphonate derivatives, a ratio of 7 to 6:1 was obtained at the same time. These agents will thus be useful for the detection and localization of acute infarct. (auth)

5880 /sup 113m/In-LABELED BONE SCANNING AGENTS. Jones, A. G.; Davis, M. A.; Dewanjee, M. K. (Harvard Medical School, Boston). Radiology; 117: No. 3, 727-730(Dec 1975).

Phosphonate analogs of EDTA and DTPA, in which the acetic acid has been replaced by methylene phosphonic acid (DTPMP and EDTMP) have been labeled with /sup 113m/In and evaluated as skeletal imaging agents. Organ distributions in rats, blood clearances in dogs, and images obtained in rabbits are presented. /sup 113m/In-DTPMP exhibits the desired characteristics to supplant ^{85}Sr and other bone-seeking radiopharmaceuticals used in areas of the world where /sup 99m/Tc is not routinely or regularly available. (auth)

5881 ^{67}Ga CITRATE IN RENAL ALLOGRAFT REJECTION. George, E. A.; Codd, J. E.; Newton, W. T.; Donati, R. M. (St. Louis Veterans Administration Hospital). Radiology; 117: No. 3, 731-733(Dec 1975).

Eight renal allograft recipients were examined on 31 occasions following administration of /sup 99m/Tc sulfur colloid and ^{67}Ga citrate. Transplant accumulation of each agent was compared and collated with the clinical diagnosis. The procedures matched in 25 instances (81 percent). Gallium accumulated in the graft producing a false positive result in 2 instances of acute tubular necrosis with anuria, and failed to accumulate within the graft in one case of chronic rejection and in 2 instances of acute rejection. Both radioagents failed to accumulate in 3 patients with acute rejection following heparin therapy. These data indicate that /sup 99m/Tc sulfur colloid is superior to ^{67}Ga citrate in establishing the diagnosis of transplant rejection and also provides more timely information. (auth)

5882 QUANTITATION OF AVIAN RNA TUMOR VIRUS REVERSE TRANSCRIPTASE BY RADIOIMMUNOASSAY. Panet, A.; Baltimore, D.; Hanafusa, T. (Massachusetts Inst. of Tech., Cambridge). J. Virol.; 16: No. 1, 146-152(Jul 1975).

A radioimmunoassay was developed that can detect and quantitate 3 ng or more of the avian RNA tumor virus reverse transcriptase. The assay detected no antigenic sites in Rous sarcoma virus alpha virions or in virions of a murine RNA tumor virus. About 70 molecules of reverse transcriptase were found per virion of avian myeloblastosis virus with this assay or with an assay based on antibody inhibition of enzymatic activity. The assay detected about 270 ng of enzyme per mg of cell protein in virus-producing cells; uninfected cells had much less antigenic material but contained some determinants able to displace radioactive antigen. No additional antigenic determinants on reverse transcriptase could be detected that were not found on the separated alpha subunit of the enzyme. Although sevenfold less sensitive than enzymatic activity as a measure of reverse transcriptase, the radioimmunoassay can detect antigen using small amounts of protein and in the presence of inhibitors. (auth)

5883 ^{133}Xe MUSCLE CLEARANCE: A SCREENING TEST FOR ARTERIAL OCCLUSIVE DISEASE. Pozderac, R. V.; Miller, T. A.; Lindenauer, S. M. (Univ. of Michigan, Ann Arbor). Radiology; 117: No. 3, 633-635(Dec 1975).

^{133}Xe muscle clearance following ischemic exercise provides a simple, well-tolerated screening procedure for evaluating patients

suspected of having arterial occlusive disease in the lower extremities and may be useful in the follow-up of patients who have undergone corrective arterial surgery. It can be performed in nuclear medicine units capable of doing renography, and the authors feel it should be used prior to undertaking more invasive procedures such as arteriography. Methods and results of tests involving 92 legs in men are described. (auth)

5884 LIVER SCAN "HOT SPOT" IN HEPATIC VENO-OCCLUSIVE DISEASE. Hanelin, L. G.; Uszler, J. M.; Sommer, D. G. (Harbor General Hospital, Torrance, CA). Radiology; 117: No. 3, 637-638(Dec 1975).

A focal hot spot seen on a /sup 113m/In-chloride liver scan in an unusual case of hepatic venoocclusive disease bore striking similarities to scanning patterns in superior vena cava syndrome. The findings are also compared to those reported in Budd-Chiari syndrome. (auth)

5885 ARE ALL GALLIUM CITRATE PREPARATIONS THE SAME. Waxman, A. D.; Kawada, T.; Wolf, W.; Siemsen, J. K. (Univ. of Southern California, Los Angeles). Radiology; 117: No. 3, 647-648(Dec 1975).

Recent studies on brain imaging using ^{67}Ga citrate from different manufacturers revealed some clinical differences. Using chromatographic techniques, it was found that ^{67}Ga citrate supplied by vendor A clearly differed from those of vendors B and C in mobility. When citrate was added to material of vendor B to bring the final concentration to 25 mg/ml, the chromatographic mobility increased dramatically. Addition of benzyl alcohol had no effect. The mechanisms involved in causing these chromatographic changes are not clear; however, the in vitro variations noted indicate a difference in chemistry which may ultimately affect the distribution and localization of the radiopharmaceutical. (auth)

5886 STAPHYLOCOCCAL ENTEROTOXIN C: SOLID-PHASE RADIOIMMUNOASSAY. Bukovic, J. A.; Johnson, H. M. (Food and Drug Administration, Cincinnati). Appl. Microbiol.; 30: No. 4, 700-701(Oct 1975).

A solid-phase radioimmunoassay test employing ^{125}I-labeled enterotoxin C and polystyrene tubes coated with specific antibody was used for the detection and quantitation of enterotoxin C in condensed milk, cheddar cheese, custard, and ham salad. The assay was sensitive to 1 to 10 ng of toxin per g of food; nonspecific inhibitions were 16% or less. (auth)

5887 STUDY ON SEX-SPECIFIC TRANSFERRIN POLYMORPHISM AND ON THE IDENTIFICATION OF TRANSFERRINS BY RADIOACTIVE LABELLING. Major, F.; Behne, D.; Tawfik, E. S. (Technische Univ., Berlin). Experientia; 31: No. 10, 1175-1177(15 Oct 1975).

Sex-specific differences with regard to the intensity of transferrin bands were observed in a non-inbred adult mouse population after separation of the serum proteins by polyacrylamide gel electrophoresis. Amongst the female animals, and additional protein fraction was found just above the position of the transferrin bands. By means of a tracer method, using ^{59}Fe-labelling, it could be shown that the additional fraction is not a part of the transferrin bands. (auth)

5888 PRODUCTION OF ANTIBODIES TO AMANITINS AS THE BASIS FOR THEIR RADIOIMMUNOASSAY. Fiume, L.; Busi, C.; Campadelli-Fiume, G.; Franceschi, C. (Univ., Bologna). Experientia; 31: No. 10, 1233-1234(15 Oct 1975).

The production of antibodies against amanitins is described. By means of these antibodies, a radioimmunoassay was developed which allows detection of as little as 0.5 ng of amanitins in 1 ml of serum. By this method, the clearance of α-amanitin from the blood of poisoned mice was measured. (auth)

5889 RADIOIMMUNE ASSAY OF HETEROLOGOUS SERUM gamma-GLOBULIN IN PATIENTS RECEIVING RABBIT ANTI-HUMAN THYMOCYTE GLOBULIN. Bieber, C. P.; Lydick, E.; Griepp, R. B.; David, L. A.; Oyer, P. E.; Stinson, E. B. (Stanford Univ., CA). Transplantation; 20: No. 5, 393-398(Nov 1975).

A radioimmune assay (RIA) method for detecting heterologous serum rabbit gamma-globulin (RG) and antibody to this protein is described. The methodology is used for monitoring serum levels of rabbit globulin in patients receiving rabbit ATG (RATG). In 7 cardiac recipients receiving RATG, maximum serum levels of RG were achieved 1 to 3 days after administration of final dose. RG half-life subsequent to peak serum levels was rapid (anti X equals 36 hr) in 4 patients and prolonged (anti X equals 18 days) in 3 patients. Patient antibody to rabbit gamma-globulin was detectable only in those patients with short RG half-life. Antirabbit antibody titers in these patients were extremely low and barely detectable by RIA. (auth)

5890 SOLID-PHASE RADIOIMMUNOASSAYS FOR QUANTITATIVE ANTIBODY DETERMINATION OF CLOSTRIDIUM PERFRINGENS TYPE D EPSILON TOXIN. Bernath, S. (Justus Liebig Univ., Giessen, Ger.). Appl. Microbiol.; 30: No. 4, 499-502(Oct 1975).

Two reversed solid-phase radioimmunoassays were developed for quantitative determination of antibodies against Clostridium perfringens type D epsilon toxin. ^{125}I-labeled prototoxin was used in the bromoacetylcellulose-bound antibody method and in the antibody-coated tube method. The antibody values which can be detected by the assays are in the range of 0.004 IU/ml of investigated serum. The methods allow the screening investigation of large groups of vaccinated sheep in a rapid and inexpensive way, and are very suitable for measuring small amounts of C. perfringens D epsilon antibodies with a small experimental error. (auth)

5891 DOUBLE-ANTIBODY RADIOIMMUNOASSAY FOR STAPHYLOCOCCAL ENTEROTOXIN C_2. Robern, H.; Dighton, M.; Yano, Y.; Dickie, N. (Dept. of Health and Welfare, Ottawa). Appl. Microbiol.; 30: No.4, 525-529(Oct 1975).

A sensitive double-antibody radioimmunoassay for staphylococcal enterotoxin C_2 is described. The assay procedure employs anti-rabbit gamma globulin, prepared in goats, to precipitate the antigen-antibody complex of enterotoxin C_2 and anti-enterotoxin C_2. The test is sensitive to 100 pg of enterotoxin. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 5047, 5932, 5934, 5954, 5989, 6049, 6687, 6701, 6703, 6715, 6733, 6771, and 6874.

5892 (CONF-751101-16) STEADY-STATE CREEP MODEL FOR UO_2. Olsen, C. S. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. 5p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

From a review of out-of-pile and in-pile experiments, an analytical model was developed for the steady-state creep of UO_2: epsilon equals [(A_1 - A_2F)sigma e/sup $-Q_1$/RT//]/[A_3 + D)G^2] + [A_4sigma/sup 4.5/e/sup $-Q_2$/RT/]/[(A_5 + D)] + A_6sigma Fe/sup $-Q_3$/RT/, where A_1 equals 9,728 x 10^6, A_2 equals 3.24 x 10^{-12}, A_3 equals -87.7, A_4 equals 1.376 x 10^{-4}, A_5 equals -90.5, A_6 equals 9.24 x 10^{-28}, Q_1 equals 90,000, Q_2 equals 132,000, Q_3 equals 5200 (cal/mole), F equals fission rate (8.4 x 10^{17} to 1.18 x 10^{20} f/m^3 s), and G equals grain size. (DLC)

5893 (KFK-2168) THERMAL LATTICE DILATATION OF SOME TRANSITION METAL COMPOUNDS. Politis, C. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Aug 1975. 98p. (In German). Dep. NTIS (US Sales Only) $6.00.

Thesis.

The report deals with the thermal lattice dilatation of cubic transition metal compounds, as determined through the variation of the lattice constants using a high-temperature x-ray diffractometer chamber. The evaluation relates to both the linear thermal expansion coefficient and, for some compounds, the specific heat at constant volume C_V and the Grueneisen constant. In general, a higher thermal dilatation is observed for nitrides than for carbides with the compounds formed by the transition metals belonging to the IVA and VA groups. The influence exerted by vacancies and by the oxygen dissolved in the lattice on the thermal dilatation of carbonitrides of zirconium, hafnium, and tantalum is explained by the more pronounced anharmonic character of atomic vibrations in the crystal lattice. The following compounds were considered in particular: UC, UN, $UC_{1-x}N_x$, US, ThC, $ThC_{1-x}N_x$, ThN, Th_4H_{15}, Th_4D_{15}, $ZrC_xN_yO_z$, $HfC_xN_yO_z$, $TaC_xN_yO_z$, and Hf_{1-x} $Ta_xC_{0.93}$. (73 fig, 3 tables, 136 references) (auth)

5894 (LA-4005) DEVELOPMENT OF ZrC-COATED UC-ZrC PARTICLES. Savage, A. W. Jr.; Feber, R. C.; Bertino, J. P.; Baxman, H. R.; O'Rourke, J. A.; Bard, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Contract W-7405-eng-36. 12p. Dep. NTIS $4.50.

Declassified 11 Jun 1975.

Zirconium carbide coatings were deposited on $U_{0.3}Zr_{0.7}C$ cores from zirconium tetrachloride-methane-hydrogen-helium mixtures at 1400°C in an attempt to develop improved coated particles for use in Rover graphite-matrix fuel elements. The coated particles were tested at 2500°C. Those with coatings thin enough to satisfy the requirements of small particle size and high uranium content survived heating in a tungsten container but failed when heated in graphite crucibles, presumably owing to rapid diffusion of carbon through the ZrC coating and formation of a low melting (2400°C) ternary eutectic with the core. Increasing the coating thickness from about 20 to about 45 mu enabled the particles to withstand heating in graphite at 2500°C because of the interdiffusion of core and coating to form a higher melting solid solution, but the uranium content of these particles was too low for use in Rover graphite-matrix fuel elements. (auth)

5895 (RISO-327) METALLURGY DEPARTMENT PROGRESS REPORT, 1 JANUARY–31 DECEMBER 1974. (Danish Atomic Energy Commission, Risoe, Research Establishment). May 1975. 56p. Dep. NTIS (US Sales Only) $5.50.

A description is given of the activities of the Metallurgy Department at Risø during 1974. The main fields of work are: general materials research, materials development, fuel elements and fuel modeling, and materials technology. Two articles, one on computer modeling and testing of UO_2–Zr fuel pins, the other on plastic deformation of polycrystals, are also included. A survey is given of the department's participation in international collaboration and of its activities within education and training. A list (with abstracts) of publications and lectures by the staff of the department during 1974 is included. (auth)

5896 THREE-BODY-FORCE SHELL-MODEL STUDY OF PHONON DISPERSION IN THE TRANSITION-METAL CARBIDES TaC AND HfC. Verma, M. P.; Gupta, B. R. K. (Agra Coll., India). Phys. Rev., B; 12: No. 4, 1314-1318(15 Aug 1975).

Phonon dispersion curves of two transition-metal carbides TaC and HfC have been derived from the three-body-force shell model (TSM). To account for the absence of the Lyddane-Sachs-Teller splitting between the long-wave optic-mode frequencies the model has to be so set as to give a zero value to the Lundqvist effective charge. The TSM results are found to agree well with the experimental curves of Smith and Glaser and are in this regard much better than the pseudopotential calculations of Mostoller and almost as good as the double-shell-model and the simple-screened-shell-model results of Weber for TaC and HfC, respectively. (auth)

5897 DEFECT STRUCTURE OF NONSTOICHIOMETRIC VANADIUM DIOXIDE AT HIGH TEMPERATURES. Balabaeva, R. F.; Vasil'eva, I. A.; Gerasimov, Ya. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 221: No. 1, 113-116(1975). (In Russian)

In correspondence with general concepts on the defect structures of dioxides having insufficient and excess oxygen it can be assumed that the main type of defects near the lower phase limit α in $VO_{2-\alpha}$ will be vacancies of oxygen atoms (v_O) or vacancies at the interstices (V_i), while near the upper phase limit beta β in $VO_{(2+\beta)}$ the defects will be either oxygen atoms at the interstices (O_i) or vacancies of vanadium atoms (v_V). Changes in enthalphy (ΔH) and entrophy were determined for various defect oxides. Values of ΔS and ΔH varied monotonically, and this behavior indicated that there were no shifts in defect type. The oxygen activity was related with the deviation from stoichiometry (x). Free energies ΔG were calculated for values of x in VO_x ranging from 1.98 to 2.02. The calculated and experimental values of ΔG agree well with each other. (SJR)

5898 HEAT-RESISTANT COATINGS FOR NONMETALLIC MATERIALS. Sazonova, M. V.; Gorbatova, G. N.; Karpichenko, E. A. pp 28-36 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

A method is described for preparing heat-resistant coatings in air at 500 to 900°C. With this method it is possible to protect graphite, graphite-containing materials, and the borides of Ta, Nb, and Zr from disintegration during extended heating in air up to temperatures of 1400°C. The change in weight of the samples with coatings after 100 h at 1300°C is within the limits of 0.4 to 3.2 mg/cm^2. The microstructure and the phase composition of the coatings were determined. (tr-auth)

5899 BEHAVIOR OF NIOBIUM CARBIDE IN LOW-TEMPERATURE PLASMA JET AND PROPERTIES OF THE COATING FORMED. Blokhin, V. S.; Saksel'tsev, V. G.; Mel'nikov, E. V.; Solov'ev, B. M.; Sukhanov, A. N.; Krasinskii, B. M. pp 117-122 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings, Leningrad, USSR (20 Mar 1973).

Data were reported on the effect of the working gas on the chemical and gaseous properties of coatings. The dependence between the volt-ampere characteristics of the process and the concentration of oxygen and carbon in the coating material was determined. It was established that the crystalline lattice of the carbides during plasma deposition in air was deformed in the macro- and microlevels with a high degree of anisotropy of the properties. (tr-auth)

5900 INTERPRETATION OF THE PHASE COMPOSITION OF PLASMA-DEPOSITED NIOBIUM CARBIDE-BASED COATING USING MICRO X-RAY AND CHROMATIC MICROSTRUCTURAL ANALYSES. Blokhin, V. S.; Mel'nikov, E. V.; Telegin, G. P.; Virnik, A. M.; Chudinov, M. G. pp 122-128 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

Simultaneous micro x-ray analysis and chromatic structural analysis made it possible to interpret the basic phases observed in the niobium carbide coating. The Nb(O;C) phases were colored in blue tones. The NbC phase was light brown and white. The phases from NbC to Nb were dark brown. The character of the distribution of carbon and oxygen niobium carbide particles during deposition in air was studied. (tr-auth)

5901 EFFECT OF SEVERAL FACTORS ON DIFFUSION PROCESSES IN METAL–COATING SYSTEMS. Babushkin, V. N.; Bashilov, S. M.; Borisenko, A. I. pp 181-183 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

Two methods of inhibiting diffusion in metal–coating systems were examined: by the introduction of an impurity into the coating which decreases the rate of diffusion of the protected metal into the coating and by the deposition of a barrier layer at the interface. The results showed that the admixture of some metals and nonmetals can inhibit the diffusion of the metal into the coating as a function of the concentration, and valence of the admixture, and the temperature at which it is used. The use of thin Y barrier layers in conjection with coatings of Mo–Cr–Si–B almost completely inhibit diffusion. (JSR)

5902 BOROSILICIDING MOLYBDENUM AND NIOBIUM. Sosnovskii, L. A.; Epik, A. P.; Kaplina, G. S.; Khorpyakov, O. T. pp 189-195 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The results of the separate sequential impregnation of Mo and Nb with B and Si were reported. It was shown that with different order of impregnation with these elements and different technological regimes, both boride and silicide phases can be introduced in the coatings formed. On the basis of the results obtained and available literature data, an analysis was made of the performance of coatings obtained under different borosiliciding conditions. It was shown that only sequential saturation with B and then with Si leads to the preparation of coatings with good protective properties. (tr-auth)

5903 USE OF BORIDE COATINGS AS DIFFUSION BARRIERS FOR REFRACTORY METALS. Burykina, A. L.; Dzyadykevich, Yu. V.; Epik, A. P.; Sosnovskii, L. A. pp 195-203 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The formation kinetics and the structure of the intermediate phase during the interaction of silicide and borosilicide coatings with refractory metals were studied in the temperature interval of 1200 to 1400°C for Nb and 1400 to 1600°C for Mo and W for annealing times up to 10 h in a vacuum. It was established that in the silicide coatings transition of the disilicide into lower silicide phase occur. In the borosilicide coatings on Mo and W the ternary phase $Me_5(B, Si)_3$ form at the boundary of the silicide and borosilicide layers. This prevents the further conversion of the disilicide into lower silicides. For Nb with barrier properties the monoboride NbB is formed. The use of boride sublayers is promising for the prevention of the interaction of silicide coatings with the refractory metals. (tr-auth)

5904 PREPARATION AND STUDY OF THE PROPERTIES OF Al–Cr–SILICIDE COATINGS ON NIOBIUM. Gordeeva, L. T.; L'vov, V. S.; Sosul'nikova, M. A.; Yupatova, L. S.; Vyazigina, L. V.; Khrenova, E. P. pp 223-229 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

A technology was developed for the preparation of Al–Cr–silicide coatings on Nb. The phase composition and structure (before and after heat-resistant tests at 1200 and 1700°C) were studied. (tr-auth)

5905 EFFECT OF DIFFUSION BORIDE COATINGS ON THE HEAT RESISTANCE OF NICKEL AND THE NICKEL ALLOY VZhL-14. Pasechnik, S. Ya.; Borsyakov, A. S.; Gol'denberg, B. S.; Venevtsev, Yu. M.; Korotkov, V. D. pp 234-240 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The effect of diffusion boride coatings on the heat resistance and dislocation structure of Ni was examined. It was established that in the interval from 450 to 750°C boride coatings increase the heat resistance of Ni and Ni-based alloys by 25 to 30%. The processes of nucleation and propagation of microfissures in the boride layer were examined. (tr-auth)

5906 COMPARATIVE STUDY OF THE HEAT RESISTANCE AND THERMAL STABILITY OF MOLYBDENUM DISILICIDES AND SOME MONOCARBIDES. Gordeeva, L. T. pp 406-410 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

A comparative study was made of the heat resistance of $MoSi_2$ and BC, TiC, WC, Cr_3C_2, and SiC, and SiC. It was shown that the carbides of Si and Cr had the greatest heat resistance in air at 1350°C. $MoSi_2$ showed similar heat resistance only after the formation of a protective film of a required thickness. (tr-auth)

5907 STRUCTURE AND PHASE COMPOSITION OF Ni–Cr–Si–B ALLOYS. Antonova, E. A.; Sinai, L. M. pp 418-428 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The phase composition and structure of alloys with a systematically changing composition (Ni–40 to 90%, Cr–10 to 50%, Si–0 to 15%, and B–5%), obtained by sintering powdered mixtures in the presence of the liquid phase were studied at temperatures up to 1200°C. (tr-auth)

5908 SMALL-RADIUS POLARONS IN VANADIUM PENTOXIDE. I. Polar Absorption in V_2O_5. Volzhenskii, D. S.; Savitskii, V. G. (Lvov State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 91-94(1975). (In Russian)

On the basis of previous experimental results on the IR absorption spectra of V_2O_5, it was assumed that in this compound close to stoichiometry the carriers are localized on the regular lattice sites, but during reduction of V_2O_5 secondary centers of localization are formed consisting of pairs of V sites. Analysis of the conductivity of small-radius polarons, based on experimental data and theoretical considerations, led to the conclusion that polarons localized on pairs of V sites are adiabatic. Polarons localized on regular lattice sites are non-adiabatic. (JSR)

5909 MAGNETOTHERMODYNAMICS OF FERROELECTRIC, FERROELASTIC, ANTIFERROMAGNETIC β-TERBIUM MOLYBDATE. I. Heat Capacity, Entropy, Magnetic Moment of the Electrically Polarized Form From 0.4 to 4.2°K with Fields to 90 kG Along the c Crystal Axis. Fisher, R. A.; Hornung, E. W.; Brodale, G. E.; Giauque, W. F. (Univ. of California, Berkeley). J. Chem. Phys.; 63: No. 3, 1295-1308(1 Aug 1975).

The magnetic moment and heat capacity of a 1.170 cm dia spherical single crystal of electrically polarized β-$Tb_2(MoO_4)_3$ have been measured at stabilized fields of 500, 1,000, 1,500, 2,500, 5,000, 10,000, 15,000, 25,000, 40,000, 65,000, and 90,000 G, along the c crystal axis, and over the range 0.4 to 4.2°K. The heat capacity at zero field was also measured over the same temperature range. The temperature dependent magnetic moment reached saturation at fields of 65 and 90 kG. Its value, 43,050 G cm^3/mole Tb^{3+}, corresponds to a splitting factor of $g_c = 15.41$. The small temperature independent magnetic susceptibility $\chi_{T\,ind} = 0.0070$ cm^3/mole Tb^{3+} indicates that the upper levels of the $^7F_1$ multiplet are well above the ground doublet. As expected, any effect of reversing the magnetic field with respect to the electrical polarization was too small to be detected. The T^3 lattice heat capacity was evaluated at saturating fields of 65 and 90 kG since the electronic heat capacity vanished at these high fields owing to the high g value. This also enabled evaluation of the zero entropy of the electron-lattice systems, and the effective hyperfine field which causes nuclear spin polarization. It is known from x-ray data that Tb^{3+} has two equally divided environments in β-$Tb_2(MoO_4)_3$. The magnetocalorimetric data indicate two largely independent electronic systems. The data have been separated into the two electronic, the nuclear, and lattice components of the heat capacity. Smoothed correlated values of the heat capacity, entropy, enthalpy, internal energy, magnetic moment and its isoerstedic temperature coefficient, differential isothermal magnetic susceptibility, and the isothermal work of magnetization have been tabulated over the range 0 to 90 kG and 0.5 to 4.2°K. Several magnetic moment measurements were obtained over the range 0.5 to 1.4°K with fields to 25 kG along the a crystal axis. (auth)

5910 THERMOCHEMICAL PROPERTIES OF GASEOUS ZrO AND ZrO_2. Murad, E. (Air Force Cambridge Research Labs., Hascom AFB, MA). J. Chem. Phys.; 63: No. 3, 1133-1139(1 Aug 1975).

The dissociation energy of gaseous ZrO, $D_0^0(ZrO)$, and the heat of atomization of gaseous ZrO_2 have been measured using a high temperature mass spectrometer, A number of equilibria were studied and the following results were derived: DELTA/sub f/H (ZrO_2,g,298.15 K) equals 83 +- 12 kJ/mol, $D_0^0(ZrO)$ equals 761 +- 15 kJ/mol) (or 7.89 +- 0.15 eV), DELTA/sub f/H(ZrO_2,g,298.15 K) equals -298 +- 30 kJ/mol, and $D_0^0(ZrO_2)$ equals 1386 +- 30 kJ/mol

(or 14.4 +- 0.3 eV). The ionization potentials of ZrO and ZrO_2 were derived from the measured appearance potentials. In the case of ZrO it was necessary to make corrections for the thermal populations of low-lying electronic states. The derived values are I. P. (ZrO) equals 6.0 +- 0.2 eV, I. P. (ZrO_2) equals 9.4 +- 0.2 eV. These measurements are discussed in relation to other studies. Uncertainties in the derived thermochemical quantities owing to uncertainties in the spectral data are discussed. The chemical bonds in ZrO and ZrO_2 are briefly discussed. (auth)

5911 INVESTIGATION OF THE URANIUM–OXYGEN SYSTEM UNDER NONHYDROSTATIC STRESS CONDITIONS. Tsvigunov, A. N.; Kovba, L. M.; Zubova, E. U.; Savranskii, V. V.; Komarevtseva, N. I. Sov. Radiochem.; 16: No. 2, 237-241(1974).

Translated from Radiokhimiya; 16: No. 2, 235-239(1974).

An analysis was made of the movement of balls with waterfall conditions of operation of a ball mill. On this basis a mechanism was proposed for the formation of cubic $UO_{2.67}$. It was shown that when α-U_3O_8 is milled with balls of different diameters there is slight oxidation of uranosouranic oxide to α-UO_{3-x} ($UO_{2.88}$). The phase conversions of α-, β-, and γ-UO_3 and $UO_{2.9}$ at high pressure were investigated. Preliminary data are given on x-ray structural analysis of a high-pressure phase of α-U_2O_5. (auth)

5912 CHEMICAL VAPOR DEPOSITION OF TRANSPARENT ELECTRICALLY CONDUCTING LAYERS OF INDIUM OXIDE DOPED WITH TIN. Kane, J. (Labs. RCA Ltd., Zurich); Schweizer, H. P.; Kern, W. Thin Solid Films; 29: No. 1, 155-163(Sep 1975).

The use of the indium chelate derived from dipivaloyl methane, in combination with dibutyl tin diacetate, was investigated as a CVD technique for the preparation of transparent highly conducting layers of tin-doped indium oxide. A set of optimized deposition conditions is presented together with important optical, electrical, structural, and chemical properties of the films. Typical films of the doped indium oxide have n-type resistivity in the range 2.2×10^{-4} to 7.1×10^{-4} Ω cm. Films with the lowest resistivity exhibit an optimum dopant concentration of around 8 at.% tin in In_2O_3:Sn. Coatings were prepared on quartz or glass substrates with sheet resistances of 10–50 Ω/□ and optical transmission in excess of 80% net throughout the visible spectrum. (auth)

5913 DIELECTRIC BEHAVIOR OF DYSPROSIUM OXIDE FILMS. Goswami, A.; Varma, R. R. (National Chemical Lab., Poona). Thin Solid Films; 28: No. 2, 157-165(Aug 1975).

The dielectric properties of vacuum-deposited dysprosium oxide films have been studied in the audio-frequency range (10^2 to 10^4 Hz) at various temperatures (78 to 373°K). The dielectric constant (6.7) was independent of film thickness for thicker films (d > 1000 Å). The capacitance was dependent both on temperature and frequency, but became constant for all frequencies at low temperature. Tan δ showed a frequency minimum and its variation with frequency and temperature was in agreement with the model proposed earlier by Goswami and Goswami. The breakdown field (≃ 10^6 V cm^{-1}) followed the Forlani–Minnaja relation. The activation energy and the refractive index of these films were also measured. (auth)

5914 PROPERTIES OF Ta–Al FILMS REACTIVELY SPUTTERED IN AN ARGON–NITROGEN ATMOSPHERE. Schoen, J. M. (Bell Telephone Labs., Holmdel, NJ); Gerstenberg, D.; Hartwig, C. T. Thin Solid Films; 28: No. 2, 251-264(Aug 1975).

The effect of nitrogen doping on the electrical and structural properties of Ta–Al films has been investigated. The Ta–Al–N films were prepared by sputtering from composite Ta–Al cathodes in an argon–nitrogen atmosphere. Two series of such films were prepared. Series 1 films consisted of 63% Ta–37% Al, and series 2 films consisted of 55% Ta–45% Al when sputtered in argon only. The nitrogen partial pressure was varied from 5.0×10^{-6} to 1.0×10^{-3} torr. Results of electron microprobe analysis indicated that the Al:(Al + Ta) ratio varied with nitrogen partial pressure only in series 2 films. X-ray diffraction analysis suggested the existence of an fcc phase in the series 1 films and of an hcp phase in series 2 films. The phase changes in the film were reflected in the resistivity and absolute thermoelectric power. The resistivity increased sharply while the temperature coefficient of resistance (t.c.r.) decreased slowly (becoming more and more negative) with increasing nitrogen content until the films transformed to the fcc or hcp phase. The t.c.r. then dropped precipitously. After these transformations the resistance was markedly non-linear in its variation with temperature, suggesting the dominance of a thermally activated conduction process. In order to evaluate Ta–Al–N films for possible use as a resistor material, a study of their anodizability was undertaken. A 1:1 solution of aqueous saturated oxalic acid-ethylene glycol was a satisfactory electrolyte. It was found that the scintillation voltage fell off with increasing nitrogen content in the Ta–Al–N films. During the anodization process gas evolution occurred at the oxide-electrolyte interface for all nitrogen doping levels. It became severe at high doping levels and seriously limited the ability to form protective anodic films. Power-aging studies of Ta–Al–N resistors indicated that their stability deteriorated with increasing nitrogen content. This, together with the anodization results, suggests that further development of the Ta–Al–N system using conventional anodic resistor processing is not merited. Alternative processing techniques do seem feasible. (auth)

5915 OPTICAL LOSSES OF EVAPORATION-DEPOSITED DIELECTRIC WAVEGUIDES. Kersten, R. T.; Mahlein, H. F.; Rauscher, W. (Research Labs. of Siemens AG, Munich). Thin Solid Films; 28: No. 2, 369-374(Aug 1975).

The optical attenuation and the refractive indices of evaporation-deposited Al_2O_3, CeO_2, MgO, ZrO_2, CeF_3, LaF_3, NdF_3 and ZnS dielectric films have been measured using the films as optical waveguides. The attenuation resulting from absorption in the planar waveguide and substrate as well as from light scattered in the waveguide and at its interfaces with the substrate and superstrate is not below 10 dB cm^{-1} and allows a qualitative comparison of the materials conventionally used in interference optics for the deposition of low-loss single layers or multilayers. Owing to their relatively high attenuation, the materials investigated are only suitable for short waveguides where severe demands have to be met with respect to the refractive index. Short optical paths are usually realized by the concentration of optical devices in integrated optics technology. Difficulties are likely to be encountered, however, in experimental integrated optical structures, which are often of large-area design in the interests of simplicity and easy handling. (auth)

5916 ELECTRICAL PROPERTIES OF DIELECTRIC THIN FILMS OF THE TANTALUM OXIDE-QUARTZ SYSTEM PREPARED BY R. F. REACTIVE SPUTTERING. Umezawa, T.; Yajima, S. (Hokkaido Univ., Sapporo). Thin Solid Films; 29: No. 1, 43-52(Sep 1975).

Electrical properties of mixed tantalum oxide-quartz films, prepared by reactive sputtering from tantalum-quartz composite targets with various area ratios at the target surface, are described. (7 fig) (auth)

5917 TWO-PHASE STAGE OF BORON NITRIDE FOLLOWING IMPACT COMPRESSION. Kurdyumov, A. V.; Pilyankevich, A. N.; Alekseevskii, V. P.; Yarosh, V. V. (Inst. of Problems in Materials Science, Kiev). Sov. Phys. - Tech. Phys. (Engl. Transl.); 20: No. 1, 128-129(Jul 1975).

Translated from Zh. Tekh. Fiz.; 45: No. 1, 195-197(Jan 1975).

A study was made of the two-phase BN structures (wurtzite-like and graphite-like phases) produced by impact compression. It is shown that the graphite-like phase is due chiefly to the formation of a quantity of the material with a turbostatic structure. (DLC)

5918 INVESTIGATION OF PHOSPHORESCENCE OF SYNTHETIC RUBIES AND SAPPHIRES STIMULATED BY ^{60}Co γ-RAYS. Krylov, K. I.; Sharlay, S. F.; Kolesnikov, V. M. Tr., Leningr. Inst. Tochn. Mekh. Opt.; No. 79, 17-20(1975). (In Russian).

Phosphorescence of various specimens of ruby crystals grown by different methods with different concentrations of Cr_2O_3 as well as synthetic leucosapphires when stimulated by gamma rays was studied. Visual observation of a number of specimens showed that the intensity and spectral composition of de-excitation were different for different specimens. Among the investigated crystals the brightest fluorescence was shown by leucosapphires, with individual specimens fluorescing in bright blue, blue-violet, green, or reddish light. The fluorescence of rubies, sapphires, and some leucosapphires was weaker. Fluorescence was observed for a fairly long time after cutting off the stimulating radiation, which indicates phosphorescent de-excitation. It is hypothesized that the observed de-excitation is of the recombination type; however, further detailed research is needed to establish the exact mutual relation between the development of color centers in the α-Al_2O_3 lattice, their interaction with Cr^{3+} ions and the change of valency of the latter, and to determine the influence of other impurities (such as titanium, vanadium, iron and so forth), including uncontrollable impurities, on the enumerated processes. (Ref. Zh.)

5919 CRYSTALLOGRAPHIC, ELECTRICAL, AND MAGNETIC PROPERTIES OF THE SYSTEM La/sub 1-x/Sr/sub x/VO_3. Dougier, P.; Hagenmuller, P. (Univ. Bordeaux, Talence, France). J. Solid State Chem.; 15: No. 2, 158-166(Oct 1975). (In French).

The crystallographic, electrical, and magnetic properties of the system La/sub 1-x/Sr/sub x/VO_3 have been investigated as a

function of x. An insulator reversible metal transition appears for x approximately equal to 0.225; it may be described as a Mott-Anderson transition in an impurity band. (auth)

5920 CHARGE-TRANSFER ABSORPTION BAND OF Eu^{3+} IN OXIDES. Hoefdraad, H. E. (Univ., Utrecht). J. Solid State Chem.; 15: No. 2, 175-177(Oct 1975).

The position of the charge-transfer band of Eu^{3+} in the absorption spectra of a number of oxides is discussed. It is shown that this position is more or less fixed in octahedral VI coordination and that it varies in VIII and XII coordinations as a function of the effective ionic radius of the relevant host lattice ion. (auth)

5921 STUDY OF THE FERROELECTRIC PROPERTIES OF SOME TERNARY OXIDES OF THE PYROCHLORE TYPE. Jeanne, G.; Desgardin, G.; Allais, G.; Raveau, B. (Univ., Caen, France). J. Solid State Chem.; 15: No. 2, 193-202(Oct 1975). (In French).

Ferroelectric properties of new pyrochlores of the systems $Cd_2Nb_2O_7$-Bi_3NbO_7-"$Zn_2Nb_2O_7$", $Cd_2(Nb/sub\ 2-x/Sb/sub\ x/)O_7$ and $Cd/sub\ 2-x/Bi/sub\ x/(Nb/sub\ 2-x/Ti/sub\ x/)O_7$ have been studied. The evolution of the Curie temperature of these compounds, and of known pyrochlores is discussed. (auth)

5922 MAGNETICALLY CONTROLLED ELECTRON LOCALIZATION IN Eu-RICH EuO. Kuebler, J. (Ruhr-Univ., Bochum, Ger.); Vigren, D. T. Phys. Rev., B; 11: No. 11, 4440-4449(1 Jun 1975).

A calculation of the linear-response properties of an electron gas, coupled by the s-f exchange interaction to a lattice of localized spins, is presented. Coupled-charge and spin-density-response functions are determined in the random-phase approximation and used to compute a Mott-type instability of metallic Eu-rich EuO toward formation of magnetic polarons bound to oxygen vacancies. Critical carrier densities are obtained as a function of temperature and phase diagrams of the metallic and insulating states are presented and compared with existing theories and experimental results. (auth)

5923 ENERGY BANDS, ELECTRONIC PROPERTIES, AND MAGNETIC ORDERING OF CrB_2. Liu, S. H. (Ames Lab., IA); Kopp, L.; England, W. B.; Myron, H. W. Phys. Rev., B; 11: No. 9, 3463-3468(1 May 1975).

Energy bands of CrB_2 were calculated using the Korringa-Kohn-Rostoker method in the muffin-tin-potential approximation. The bands near the Fermi level have mostly Cr d character, and one of the bands gives rise to a very flat piece of Fermi surface perpendicular to the hexagonal axis. It is proposed that this piece of Fermi surface stabilizes a spin-density-wave state which manifests itself as antiferromagnetic ordering of the compound below 85°K. The excess specific heat and electronic-spin susceptibility is also interpreted as due to exchange enhancement. (9 figures) (auth)

5924 STUDY OF THE OXIDATION KINETICS OF VANADIUM CARBIDE. Santafe, C.; Borgianni, C. (Centro Sperimentale Metallurgico, Rome). Oxid. Met.; 9: No. 5, 415-425(Oct 1975).

The oxidation of an oxycarbide of vanadium, $VO_{0.6}C_{0.7}$, and of a vanadium carbide, $VC_{0.98}$, was studied athermally up to temperatures of 800°C and isothermally between 400 and 580°C at oxygen pressures ranging from 10^{-2} to 1 atm. The oxycarbide followed the parabolic rate law below 450°C with V_2O_5 forming as the only reaction product. The activation energy was 49 kcal/mole. $VC_{0.98}$ did not form an oxide in this temperature range, but rather dissolved oxygen, the activation energy being 26.6 kcal/mole. No oxygen pressure dependence on the kinetics was found for either sample in this temperature range. Both samples followed the cubic rate law during oxidation in the range of 500 to 580°C during which V_2O_5 formed. There was a P/sup 1/3/ dependence and the activation energy was the same for both materials, 51 kcal/mole. The cubic rate law and the positive pressure dependency (rather than an anticipated negative dependency) were attributed to an electric field associated with oxygen ions chemisorbed on a thin layer of V_2O_5. (auth)

5925 BORON NITRIDE COMPOSITES BY CHEMICAL VAPOR DEPOSITION. Pierson, H. O. (Sandia Labs., Albuquerque, NM). J. Compos. Mater.; 9: 228-240(Jul 1975).

Composites of boron nitride (BN) have been made by the chemical vapor deposition (CVD) of a BN matrix on a BN felt fiber substrate. Reactant gases were boron trifluoride and ammonia. The composites have a relatively high density (1.70 g/cm^3), a crystallite size L/sub C/ equals 150 A and an interlayer spacing d_{002} equals 3.35 A. Measurements of elastic modulus and thermal conductivity and expansion showed some anisotropy as a result of the preferred fiber orientation of the substrate. (auth)

5926 STRENGTH OF ZIRCONIUM DIBORIDE CERAMICS AFTER CYCLIC LOADING OR HEATING. Strauss, E. L.; Kiefer, T. F. (Martin Marietta Corp., Denver). J. Am. Ceram. Soc.; 58: No. 9-10, 399-401(1975).

From 76th annual meeting of the American Ceramic Society; Chicago, IL, USA (1 May 1974).

Strength losses in diboride ceramics resulting from load cycling near ultimate strength and from thermal cycling to 3000°F were investigated. Specimen configurations included notched and unnotched flexural specimens as well as specimens oriented in 3 orthogonal directions with respect to the billet pressing direction. Flexural fatigue testing for 2 to 8 million cycles produced no failures when stress levels were below 80 percent of flexural control strengths. Static loading of specimens that survived the fatigue test revealed no strength deterioration as a result of stress cycling. Thermal exposure produced an oxide coating; strength reductions caused by thermal cycling could be correlated with the thickness of this coating. (auth)

5927 TRANSPORT PROCESSES IN COMPOSITE MEDIA. Davis, H. T. (Univ. of Minnesota, Minneapolis); Valencourt, L. R.; Johnson, C. E. J. Am. Ceram. Soc.; 58: No. 9-10, 446-452(1975).

From joint fall meeting of the Basic Science and Nuclear Divisions of the American Nuclear Society; Williamsburg, VA, USA (1 Oct 1974).

Transport processes in two types of composite media were investigated. In one type, exemplified by hydrogen diffusion in steel with microvoids present, short-lived trapping reactions result in a lowering of the effective or overall diffusion coefficient. The other type of composite consists of randomly mixed parts or phases having no interfacial resistance or trapping. The percolation properties of such systems are reviewed, and thermal conductivity, self-diffusivity, and gas permeability in certain porous solids are analyzed in the light of percolation theory. (auth)

Metals and Alloys

Refer also to abstract 6736.

5928 (ORNL-TM-5027) STEAM GENERATOR MATERIALS TECHNOLOGY PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1975. Patriarca, P. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 292p. AT.

Results of research are reported in programs on steam generator materials for the CRBR plant, advanced ferritic alloys for LMFBR steam generators, alloy 800 development for LMFBR steam generators, tube sheet forging, and development of alternate structural materials for LMFBR type reactors. (JRD)

5929 (RDT-M-5-8T(10-75)) NICKEL-MOLYBDENUM-CHROMIUM ALLOY SHEET AND PLATE (ASME SB-434 WITH ADDITIONAL REQUIREMENTS), OCTOBER 1975. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). 17 Oct 1975. 9p. RSO.

This standard covers Ni-Mo-Cr alloy sheet and plate for nuclear and associated applications. Heat treatment, testing, examination, etc. are covered. (DLC)

5930 VACUUM ANNEALING OF TITANIUM ALLOYS. Borisova, E. A.; Shashenkova, I. I.; Krivko, A. I.; Barasheva, T. V. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 313-316(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 37-41(Apr 1975).

The optimal temperature range for hydrogen removal in vacuum annealing is 550 to 650°C for OT4, VT20, VT6S, and VT14 (Al, V, Mo, Zr). The holding time depends on hydrogen concentration, thickness, and hydrogen concentration desired. Presence of oxide films formed during annealing in air at temperatures up to 500°C has no effect on the properties of titanium alloys after subsequent vacuum annealing. During vacuum annealing of samples with an oxidized surface the oxides dissociate and oxygen diffuses into the depth of the metal, which impairs the mechanical properties. (auth)

5931 TAKE A LOOK AT LEAD TO LOCK OUT CORROSION, RADIATION, AND NOISE. Miska, K. H. Mater. Eng.; 81: No. 3, 22-25(Mar 1975).

The properties and uses of Pb alloys in applications for corrosion control, nuclear radiation attenuation, and noise dampening are reviewed. Lead can be rolled down to 0.198 mm thick and foil is available as thin as 0.0127 mm. Lead is also readily available as extrusions, die castings, powder, fibers, laminates, and shot. Mechanical and physical properties of commercial Pb and its alloys are tabulated. (Metals Abstr.)

5932 INORGANIC AND ORGANOSILICATE COATINGS. All-Union Conference Held at Leningrad, USSR, 20–23 March 1973. Leningrad; Izdatel'stvo Nauka (1975). 481p. (In Russian). (CONF-730375–).

The papers presented at the conference are compiled. The topics discussed were basic problems in the preparation of coatings, vapor-deposited coatings, coatings obtained by diffusion saturation, coatings deposited by fusion, coatings for short-term effects, coatings for low-temperature requirements, and structure and properties of coatings. Separate abstracts were prepared for 16 of the papers. (JSR)

For abstracts of individual papers see: 5898–5907, 5938, 5939, 5949–5951, and 5988.

5933 COMPATIBLE COATINGS FOR CORROSION RESISTANT AEROSPACE FASTENERS. Taylor, E. Elektrokhimiya; 13: No. 2, 29-30(Feb 1974).

Corrosion resistant and high-strength fastening alloys are replacing the corrosion-prone plated alloy steels in aerospace applications. These new fasteners can provide joints which are most reliable than any previously available. Adequate coating precautions must be taken to prevent attack of Al structure or H embrittlement of the bolt. All coating possibilities should be considered carefully before an engineering decision is made. The following bolt alloys are considered: Custom 455 and PH 12-9 Mo and PH 13-8 Mo steels, Inconel 718 alloy and MP35N (Co–Cr–Ni–Mo) alloy. (Metals Abstr.)

Corrosion and Erosion

Refer also to abstracts 5093 and 5901–5905.

5934 (SC-RR-64-605) MATERIAL INTERACTIONS OF THE OPERATIONAL SNAP-9A GENERATOR. Sasmor, D. J.; Wessling, F. C. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1964. 35p. Dep. NTIS $4.75.

Declassified 20 Oct 1975.

The design of the SNAP-9A generator includes a number of different materials in intimate contact. The possible interactions among the materials and their effect on the postulated re-entry breakup sequence of the generator are discussed. Experimental evidence obtained under static vacuum conditions for all of the interactions possible is presented. (auth)

5935 (UCRL--51869) EXPOSURE OF HIGH-TEMPERATURE ALLOYS IN CARBONACEOUS GAS ATMOSPHERES. Goldberg, A.; Perkins, A. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Sep 1975. Contract W-7405-Eng-48. 24p. Dep. NTIS $4.00.

Light and scanning electron microscopy were used to evaluate changes resulting from exposure of eight commercial high temperature alloys in carbonaceous atmospheres. Samples were exposed in CO, CH_4, or CO/CH_4 mixtures up to 900°C and 6.2 MPa. All alloys were actively attacked. Surface finish and preoxidation influenced the extent of corrosion. Reduction of NiO, giving a high surface concentration of Ni, promoted catalytic decomposition of CH_4. Further work is indicated before the performance of these alloys may be ranked with confidence. (auth)

5936 FERRITIC STAINLESS STEELS WITH HIGH CHROMIUM CONCENTRATIONS THAT ARE TOUGH AND RESISTANT TO CORROSION CRACKING, PITTING CORROSION, AND STRESS CORROSION. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 270-271(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 75-76(Mar 1975).

Additions of 1 to 2% Mo to 20–40% Cr steels combines the C and lowers the ductile-brittle temperature. Effects of strain hardening on mechanical properties are listed. The steels become brittle when heated at 350 to 550°C. The general and stress corrosion resistance of the steels was tested in acid and chloride solutions. (DLC)

5937 OXIDATION OF HAFNIUM ALLOYS WITH NICKEL. Voitovich, R. F.; Golovko, E. I. (Inst. of Problems of Material Sciences, Kiev). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 207-209(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 23-26(Mar 1975).

Alloying of hafnium with 2 to 8% Ni substantially increases its scale resistance, evidently due to formation of HfNi at the scale–alloy interface, which along with the intermetallic phases substantially reduces the solution of oxygen in the alloys. (auth)

5938 EFFECT OF THE COMPOSITION OF THE TITANIUM ALLOY ON THE DEVELOPMENT OF DIFFUSION-CHEMICAL PROCESSES DURING HIGH-TEMPERATURE HEATING IN AIR AND IN SILICATE MELTS. Sitnikova, A. Ya.; Fedorov, V. N.; Borisenko, V. A.; Koroleva, N. V.; Piryutko, M. M.; Kalinina, A. M. pp 36-48 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The alloys Ti–10Al, Ti–10Sn, Ti–10Zr, Ti–10Mo, Ti–10V, Ti–10Cr, Ti–10Mn, Ti–5Al–10Cr, Ti–8Al–1V–1Mo, Ti–3Al–7Mo–10Cr, and Ti–3Al–4Mo–6V–10Cr were studied. In the alloys with β-stabilizing elements (V, Mo, Cr, and Mn) heated in air, a widely extended air-saturated zone, enriched at the surface by the alloying addition, is formed; the phenomenon was not observed in samples heated in a melt of $Na_2O \cdot 2SiO_2$. These results indicate that β-stabilized Ti alloys can be protected by a silicate coating during high-temperature heating. (tr-auth)

5939 REGULARITIES IN THE PLASMA DEPOSITION OF MOLYBDENUM ON DISKS OF THE TITANIUM ALLOY VT9. Arabei, B. G.; Lazarenko, G. P.; Loskutov, V. S.; Rogozhin, V. M.; Saksel'tsev, V. G.; Shimbarevich, V. S. pp 109-116 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The effect of technological parameters of the deposition of Mo on VT9 backings on the efficiency of the deposition process and the properties and geometry of the coating formed was studied. (tr-auth)

5940 CORROSION AND ELECTROCHEMICAL BEHAVIOR OF METALS IN ORGANIC MEDIA. I. The Passivation and Anodic Dissolution of Molybdenum in Non-Aqueous Acetate Solutions. Tsinman, A. I.; Pischik, L. M.; Makovei, G. L. Elektrokhimiya; 10: No. 9, 1321-1327(Sep 1974). (In Russian)

In nonaqueous acetate solution, Mo became passivated, dissolution only occurring after the reversible potential for the formation of the oxide MoO_3 had been reached. Dissolution proceeded with the formation of ions with a high degree of oxidation. The apparent valency in acetate and chloride solutions was ~6. The presence of molybdic acid was identified polarographically in the anolyte. Anions, including those containing O, had little effect on the passivation and kinetics of anodic dissolution. O compounds of Mo were formed as a result of O in the acetic acid. H_2O promoted dissolution, reducing the trans-passivation potential and the slope of the anodic polarization curve. The H-evolution kinetics in acetate solutions obeyed the Tafel equation with $\alpha \simeq 0.5$ and $i_0 \simeq 10^{-5}$ A/cm² in nonaqueous acetate and chloride solutions at 90°C. (Metals Abstr.)

5941 EFFECT OF MOLYBDENUM AND HEAT TREATMENT ON CORROSION PROPERTIES OF NICKEL–MOLYBDENUM ALLOYS. Gernets, L. V.; Golovanenko, S. A.; Svistunova, T. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 1-2, 144-148 (1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 2, 47-52(Feb 1975).

Corrosion of Ni–Mo alloys containing 10, 15, 20, 28, and 34% Mo in HCl was investigated. It was found that raising the molybdenum content of Ni–Mo alloys above 30% (34% Mo) substantially improves the corrosion resistance in concentrated boiling hydrochloric acid. Alloys with 20, 28, and 34% Mo have the highest corrosion resistance after quenching. The alloys with 20 and 28% Mo are susceptible to intercrystalline corrosion (ICC) after annealing at 600 to 800°C, the reason for which is precipitation of carbides (Mo_2C and $M_{12}C$ respectively) in the grain boundaries, leading to impoverishment of boundary areas in molybdenum. Annealing of the alloy with 34% Mo leads to precipitation of γ phase throughout the grains, which increases the hardness; this alloy is not susceptible to ICC after the heat treatments investigated. (auth)

5942 HIGH-TEMPERATURE NITRIDING OF VANADIUM AND ITS ALLOYS. Lakhtin, Yu. M.; Kogan, Ya. D.; Al'-Khatib, A. (Moscow Highway Inst.). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 1-2, 132-136(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 2, 35-40(Feb 1975).

The formation of nitride coatings on V and its alloys at 900 to 1400°C was investigated. It was found that a diffusion coating forms on these materials consisting of a surface nitride zone and a diffusion sublayer. Internal nitriding consists of a multiphase solid solution region containing VN and alloying elements. (JRD)

5943 POTENTIALS OF SELECTED METAL ALLOYS IN SEA WATER AT ELEVATED TEMPERATURES. Smith, C. A.; Comp-

ton, K. G. (Rosenstiel School of Marine and Atmospheric Science, Miami, FL). Corrosion; 31: No. 9, 320-326(Sep 1975).

Sixteen metal alloys were studied in aerated sea water at temperatures up to 200°C, and five of these were further studied in deaerated sea water in the same temperature range. Galvanic series are reported for temperatures of 30, 100, 160, and 200°C in an autoclave, and for a trough at ambient conditions. The general effect of increased temperature in both aerated and deaerated sea water was to increase the electronegativity of most metals, and to reduce the spread between the median potential values. At 200°C, the metals merged into two groupings: aluminum and zinc being the most active, other metals were appreciably less negative. In contrast to other metals, zinc and carbon steel showed a tendency toward nobility at higher temperatures. Very small differences were found between the galvanic potentials of most metals in deaerated sea water as compared with these metals in aerated sea water. Titanium appeared to be the exception, being more active in deaerated sea water above 120°C. (auth)

5944 REVIEW OF THE STRESS CORROSION CRACKING OF INCONEL 600. van Rooyen, D. (Bettis Atomic Power Lab., Pittsburgh). Corrosion; 31: No. 9, 327-337(Sep 1975).

From Corrosion Research Conference; Chicago (1974).

Intergranular stress corrosion cracking (SCC) of Inconel 600 is of concern to the nuclear power industry. Heat exchangers in commercial nuclear systems have shown SCC in only a fraction of a percent of the tubes in high temperature water, but laboratory SCC of Ni-containing alloys have been demonstrated by several research groups. This review revolves around French data, which show a reversal of the usual sensitizing effect in the case of SCC in high temperature, deaerated water. There is no cracking reported in material first heated so as to precipitate carbides at the grain boundaries, whereas high temperature annealed conditions lead to intergranular SCC in the same laboratory experiments. Electrochemically, SCC and also grain boundary corrosion are related to the potential level of a given test; however, it is not yet understood how the different grain boundary zones in Inconel 600 corrode (with and without applied stress) so that the mechanism of cracking remains speculative. Cr-depletion is sufficient to explain only some cases of intergranular corrosion. Grain boundary segregation seems to be of equal or greater importance in high temperature water, especially when the attack involves SCC. Grain boundaries may become cleaned when segregated elements dissolve in chromium carbide precipitates. Physically, precipitates at grain boundaries could possibly influence the manner in which the metal undergoes strain. Hydrogen as a cause of SCC has not been ruled out. The relationship between surface films formed and SCC of Alloy 600 in high temperature aqueous environments requires more work. (auth)

5945 WEDGING ACTION OF UH_3 DURING SLOW CRACK GROWTH IN U-0.75 wt percent Ti. Magnani, N. J. (Sandia Labs., Albuquerque, NM). Corrosion; 31: No. 9, 337-338(Sep 1975).

While uranium alloys have been observed to stress corrosion crack in a variety of environments, a previous study has shown that the principal stress corrodent for U-0.75 Wt percent Ti in air and aqueous environments is H_2O. Since uranium alloys, particularly alloys with low alloy additions, react rapidly with H_2O to form uranium oxide and H_2, a program was initiated to determine the cracking behavior of U-0.75 Wt percent Ti in H_2. Preliminary data obtained from material aged at 357°C for 18 hours (sigma/sub ys/ approximately equal to 900 Mn/m^2, 130 ksi) and tested in 100 torr of H_2 are given. (auth)

5946 HYDROGEN EMBRITTLEMENT OF MOLYBDENUM. Birnbaum, H. K. (Atomic Energy Research Establishment, Harwell, Eng.); Wadley, H. Scr. Metall.; 9: No. 10, 1113-1116 (Oct 1975).

Results of tension tests at 279°K on fine-grained polycrystalline Mo sheet specimens are reported. It was found that under conditions of simultaneous tension testing and cathodic charging, the hydrogen is present at high fugacity at the tip of a crack or other stress concentrations. Thus hydrogen entry into the lattice in relatively high concentrations is possible at the point where it is most effective in causing fracture, the crack tip. Under these conditions, significant hydrogen embrittlement of molybdenum occurs. (auth)

Preparation and Fabrication

Refer also to abstracts 4973 and 5099.

5947 (UCRL-77295) ADIABATIC SURFACE THERMOMETER FOR IMPROVED PRODUCTION BRAZE QUALITY. Dittbenner, G. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Aug 1975. 13p. (CONF-751012-8). Dep. NTIS $4.00.

From SME/ERDA welding and joining workshop; Chicago, Illinois, USA (28 Oct 1975).

An adiabatic surface thermometer was developed to control automatically the critical temperature-time cycle of a production vacuum-brazing process. Investigations revealed that optimum braze-joint strength required precise control of the brazing temperature. Spot-welded thermocouples could not be used because the spot welds cause surface damage. This thermometer touches the surface and uses a differential thermocouple and heater to measure surface temperature without heat flow, thereby eliminating large errors caused by conduction losses common to conventional spring-loaded thermocouples. Temperatures in air or vacuum are measured to 800°C with errors less than 5°C. This thermometer has minimized the rejection of production parts, resulting in a cost saving to the U. S. Energy Research and Development Administration. (auth)

5948 BATH FOR ELECTROLYTIC BORIDING. Tkachev, V. N.; Grigorov, P. K.; Katkhanov, B. B. (Rostov Scientific-Research Inst. of Machine Construction Tech., USSR). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 348-350 (1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 68-70(Apr 1975).

For electrolytic boriding, a melt containing boron oxide and a component forming a metaborate of an alkali metal with it (Li, Na, K) is recommended. The boriding rate increases with the ratio of B_2O_3/Na_2O from 7 to 16. Raising the current density to 0.7 A/cm^2 also increases the depth of the boride coating. (auth)

5949 PREPARATION OF REFRACTORY METAL COATINGS BY ELECTROLYSIS OF FUSED SALTS. Baraboshkin, A. N.; Saltykova, N. A.; Talanova, M. I. pp 219-222 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

Coatings of the refractory metals Mo, W, and Re are suitable for the protection of construction materials from high temperature corrosion in liquid and gaseous reducing media (alkali metal melts, hydrogen, etc). Compact precipitates of Mo, W, and Re were obtained by electrolysis of fused salts. The singularities of the electrodeposition of the metals from fused salts were examined in comparison with the galvanic characteristics of aqueous solutions. It was shown that the different properties of the electrolytes and some special procedures can give good cohesion with the backing for Mo coatings on graphite, Ni, ceramics, and for W coatings on Ni, Cu, nichrome, stainless steel, the alloys ZhS6K and Vm-1 and the electronegative metals Ti, Cr, Zr, and others. (tr-auth)

5950 INCREASE OF THE HEAT RESISTANCE OF THE ALLOY ZhS6K BY LIQUID BERYLLIUM DIFFUSION. Anfinogenov, A. I.; Belyaeva, G. I.; Ilyushchenko, N. G.; Zvontsov, V. F.; Starkov, A. P. pp 229-233 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

The results of studies on the diffusion saturation by Be of the Ni-based alloy ZhS6K in fused salts for increasing the heat resistance of the alloy were reported. Equimolar mixture of the chlorides of Na and K with BeF_2 addition, Na, and metallic Be powder were used for the Be diffusion. Samples with Be coatings were not destroyed during 360 h at 1000°C and 560 h at 1100°C. In tests on the heat resistance the time to destruction of the coated samples was from 45 to 126 h and on uncoated samples from 27 to 54 h. A metallographic analysis was made of the coatings before and after heat-resistant tests. (tr-auth)

5951 DIFFUSION METALLIZATION FROM BATHS OF LOW-MELTING METALS. Sbozhnaya, O. M.; Shatinskii, V. F. pp 252-258 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

Experimental data on the preparation of coatings from low-melting metal compositions were reported. These coatings protect refractory metals such as Nb alloys and 1Kh18N9T steel from oxidation at high temperatures. (tr-auth)

5952 MECHANISM OF THE ELECTROPOLISHING OF MOLYBDENUM IN NONAQUEOUS ELECTROLYTES. Heumann, T.; Klimmeck, M. Werkst. Korros.; 25: No. 12, 906-909(Dec 1974). (In German).

Measurements on Mo electrodes in Mg perchlorate and LiCl solutions in ethanol, dimethyl sulfoxide, and dimethyl formamide

showed that Mo can be electropolished in perchlorate solutions. The formal valency, n, of the Mo solution in the region of electropolishing, determined from the loss in weight of the electrode, and the charge transferred is $3 \geq h \geq 2.75$. (Metals Abstr.)

5953 HEAT RESISTANT MATERIALS FOR MACHINE CONSTRUCTION. Siegfried, W. Chimia (Aarau); 28: No. 6, 301-306(Jun 1974). (In German)

The metallurgical aspects of heat-resistant steels are discussed, and the alloying effects of Mo, Cr, W, V, Ti, and Al are described. An account is given of the main types of heat-resistant materials: ferritic/martensitic; austenitic with 50% ferrite, and austenitic alloys with only small percentages of ferrite and their performances when subjected to temperatures between 450 and 750°C are tabulated. (Metals Abstr.)

5954 INTERACTION OF A PULSED LASER BEAM WITH A COMPLEX TARGET: APPLICATION TO THE PREPARATION OF COMPOUNDS IN THIN LAYERS. Desserre, J.; Eloy, J. F. (CEA, Grenoble, France). Thin Solid Films; 29: No. 1, 29-41 (Sep 1975).

The interaction of laser light beam pulses produced by a solid state laser (Q switched or normally pulsed) with different targets (Ni_3Mn, CdTe, ZrC, $ReBe_{22}$) was used to initiate evaporation. Thin films with the same composition and structure as the target are obtained by condensation of the vapor produced. A schematic model of the heating and vaporisation effects produced by the laser beam impinging on a complex target (alloy or compound) is proposed. Experimental results are in accordance with this model. (auth)

5955 FORMATION OF NIOBIUM CARBONITRIDE FROM Nb_2O_5 AND GRAPHITE IN A PLASMA ARC. Saito, M.; Matsumoto, O. (Aoyama Gakuin Univ., Tokyo). High Temp. Sci.; 7: No. 3, 167-172(Sep 1975).

A mixture of Nb_2O_3 and graphite was heated in an argon-nitrogen mixed plasma arc to form niobium excess carbonitride. Nearly stoichiometric fcc niobium carbonitride (NbC/sub x/N/sub y/, x + y approximately equal to 1) was formed by nitriding a non-stoichiometric specimen in a nitrogen atmosphere at 1500°C. Measured density values were in agreement with the x-ray densities. Products were found to be superconductors and the transition temperatures varied with composition. The highest transition temperature, observed for $NbC_{0.31}N_{0.68}$, was 17.7°K. (auth)

5956 MANUFACTURE OF HOLLOW SUPERCONDUCTORS. Naganuma, Y. (Fujikura Cable Works, Ltd., Tokyo); Yamaguchi, T.; Inoue, H.; Kono, S. pp 508-510 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Two manufacturing processes for fabricating hollow superconductors were developed to study basic problems related to forced cooling by supercritical helium. Both processes are feasible for manufacturing long conductors of various sizes without large machinery such as mechanical or hydrostatic extruders. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 5268, 5272–5274, 5281, 5284, 5288, 5316, 5324, 5337, 5338, 5521, 5648, 5927, 6061, 6066, 6068, 6069, 6323, 6324, 6505, 6508, 6510, 6805, and 6867.

5957 (CONF-750859-1) FABRICATION AND SUPERCONDUCTING PROPERTIES OF Nb_3Al MULTIFILAMENTARY COMPOSITES. Hafstrom, J. W.; Thresh, H. R. (Argonne National Lab., Ill. (USA)). Aug 1975. Contract W-31-109-Eng-38. 18p. Dep. NTIS $4.00.

From fall meeting of the American Chemical Society; Chicago, Illinois, USA (24 Aug 1975).

The metallurgy, fabrication techniques, and superconducting properties of mono- and multifilamentary aluminum-stabilized Nb_3Al wire fabricated by bulk diffusion processes are presented in detail. Emphasis is placed on the relationship of the superconducting properties to the process parameters. High superconducting critical-current densities are possible in Nb_3Al, fabricated by diffusion, only by increasing flux pinning through reduction of the grain size to below 1 mu m. Results of experiments on the control of grain size through the use of nonoxide dispersions and short diffusion times are reported. It was found that the Nb_3Al layer thickness is the most significant influencing J/sub c/(H). Zirconium additions were found to accelerate layer growth thus enabling quite short reaction times. (auth)

5958 (CONF-750913-15) CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF AMERICIUM LAVES PHASES. Aldred, A. T.; Dunlap, B. D.; Lam, D. J.; Shenoy, G. K. (Argonne National Lab., Ill. (USA)). Sep 1975. Contract W-31-109-Eng-38. 6p. Dep. NTIS $4.00.

From 4th international transplutonium elements symposium; Baden-Baden, F. R. Germany (13 Sep 1975).

An investigation was made of a series of binary americium alloys with AB_2 stoichiometry (B equals Al, Co, Fe, Rh and Ru) prepared from the ^{243}Am isotope. The C-15 ($MgCu_2$-type) structure appears in $AmAl_2$, $AmCo_2$, $AmFe_2$, and $AmRh_2$, whereas $AmRu_2$ is isostructural with $AmOs_2$ which has the C-14 ($MgZn_2$-type) structure. The magnetic properties of the cubic americium Laves phases were studied by means of magnetization and nuclear gamma-ray resonance (Moessbauer effect) measurements between 2.5 and 300°K. All the cubic Laves phases studied, except $AmFe_2$, exhibit almost temperature-independent paramagnetism. The $AmFe_2$ sample is ferromagnetic with an estimated Curie temperature of approximately 400°K. The hyperfine field at the Am site in all the compounds is small. The bulk magnetic moment of $AmFe_2$ (approximately 3 mu/sub B//F.U.) is thus associated only with the Fe atoms. The magnetic properties of the compounds are consistent with the assumption that the Am ion is in the +3 state (5f6). (auth)

5959 (CONF-751101-35) TRITIUM PERMEATION THROUGH MATERIALS FOR STEAM GENERATOR SYSTEMS. Bell, J. T.; Strehlow, R. A.; Redman, J. D.; Smith, F. J.; Savage, H. C. (Oak Ridge National Lab., Tenn. (USA)). 1975. 18p. Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Mixed isotope techniques and experimental apparatus have been developed for determining the rates of tritium permeation through metals at high temperatures. An inert gas or a controlled steam oxidizing atmosphere on the downstream side of the sample is used so that effects of surface oxidation and the formation of oxide coatings to impede tritium permeation can be determined. The validity of the method was demonstrated by determining the tritium permeability of nickel and comparing the tritium values to established hydrogen and deuterium permeabilities. The methods were applied in a long-term experiment by measuring tritium permeation through Incoloy 800 at 657°C with the downstream side of the sample continuously treated with a 750 torr sweep gas of Ar–H_2O with the H_2O partial pressure at 240 torr. Oxidation of the metal to form an oxide coating on the metal was accompanied by a decrease in the tritium permeation by a factor of 160 over a period of 84 days. (auth)

5960 (CONF-751106--3) HIGH STRAIN RATE TENSILE PROPERTIES OF ANNEALED 2¼ Cr--1 Mo STEEL. Klueh, R. L.; Oakes, R. E. Jr. (Oak Ridge National Lab., Tenn. (USA); Oak Ridge Y-12 Plant, Tenn. (USA)). 1975. 28p. Dep. NTIS $5.00.

From annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

The high strain rate tensile properties of annealed 2¼ Cr-1 Mo steel were determined and the tensile behavior from 25 to 566°C and strain rates of 2.67×10^{-6} to 144/s were described. Above 0.1/s at 25°C, both the yield stress and the ultimate tensile strength increased rapidly with increasing strain rate. As the temperature was increased, a dynamic strain aging peak appeared in the ultimate tensile strength-temperature curves. The peak height was a maximum at about 350°C and 2.67×10^{-6}/s. With increasing strain rate, a peak of decreased height occurred at progressively higher temperatures. The major effect of strain rate on ductility occurred at elevated temperatures, where a decrease in strain rate caused an increase in total elongation and reduction in area. (auth)

5961 (CONF-751106--6) MONOTONIC AND CYCLIC STRESS-STRAIN RESPONSE OF ANNEALED 2¼ Cr--1 Mo STEEL. Jaske, C. E.; Leis, B. N.; Pugh, C. E. (Oak Ridge National Lab., Tenn. (USA); Battelle Columbus Labs., Ohio (USA)). 1975. 33p. Dep. NTIS $5.00.

From annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

The stress-strain response of isothermally annealed 2¼ Cr–1 Mo steel under monotonic and cyclic loadings was characterized at 21 to 593°C. Monotonic stress-strain curves were developed for uniaxial tensile loading of specimens at strain rates of 8.33×10^{-5} and 8.33×10^{-6} s^{-1}. The cyclic stress-strain response was measured for the first 100 fully reversed strain cycles at strain ranges between 0.4 and 3.0 percent under uniaxial loading at a strain rate of 8.33×10^{-5} s^{-1}. The effects of creep, stress-relaxation, and thermal-exposure hold periods on the cyclic stress-strain behavior were also investigated at 510°C. Mono-

tonic stress-strain curves were quantified using a power law relation between stress range and plastic-strain range. Cyclic hardening was observed at temperatures up to 427°C. A mixture of initial cyclic hardening followed by later cyclic softening was seen at temperatures from 482 to 538°C, and cyclic softening was observed at 593°C. One measure of the cyclic stress-strain response was characterized by the ascending path of the stress-strain hysteresis loop for the tenth cycle. The reported results form part of the data base to be used by others in formulating similar general inelastic constitutive equations for analysis of 2¼ Cr-1 Mo steel components. (auth)

5962 (EUR-5412f) PREPARATION OF AMERICIUM METAL OF HIGH PURITY AND DETERMINATION OF THE HEAT OF FORMATION OF THE HYDRATED TRIVALENT AMERICIUM ION. Spirlet, J. C. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). Oct 1975. 127p. (In French). Dep. NTIS (US Sales Only) $7.00. EUR FB 250,-.

In order to redetermine some physical and chemical properties of americium metal, several grams of ^{241}Am have been prepared by two independent methods: lanthanum reduction of the oxide and thermal dissociation of the intermetallic compound Pt_5Am. After its separation from excess lanthanum or alloy constituent by evaporation, americium metal was further purified by sublimation at 1 100°C and 10^{-6} Torr. Irrespective of the method of preparation, the americium samples displayed the same d.h.c.p. crystal structure. As determined by vacuum hot extraction, the oxygen, nitrogen and hydrogen contents are equal or smaller than 250, 50 and 20 ppm, respectively. The heats of solution of americium metal (d.h.c.p. structure) in aqueous hydrochloric acid solutions have been measured at 298.15 ± 0.05 K. The standard enthalpy of formation of $Am^{3+}(aq)$ is obtained as -616.7 ± 1.2 kJ mol^{-1}. (auth)

5963 (GEAP-14050) CHARACTERIZATION OF TYPE-321H TUBING FOR LMFBR FUEL CLADDING. Busboom, H. J.; Appleby, W. K.; Challenger, K. D. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1975. Contract AT(04-3)-893. 41p. AT.

Type-321H stainless steel from air-melted and vacuum-melted ingots was fabricated into thin wall small diameter tubing and characterized for use in LMFBR development programs. Various fabrication routes were employed to provide annealed tubes with different solution heat treatments and grain sizes as well as tubes containing 10 and 20 percent cold work. Characterization of the tubing demonstrated that Type 321 is more complex than Type 304 or 316 and great care must be taken to select thermal-mechanical treatments to optimize grain size and stress-rupture strength. Stress rupture properties of annealed Type 321H are heavily dependent on the final annealing temperature. Higher temperature anneals gave superior stress rupture properties but this advantage was partly offset by the larger grain size which caused severe difficulties in ultrasonic inspection. While cold working improved the short term stress rupture properties, it was found that in most cases the cold worked material was inferior to the annealed material for tests in excess of 1000 hours at temperatures of 1000 to 1300°F. As far as physical and mechanical properties are concerned, it appears probable that Type 321H can be substituted for Type 316 for cladding if adequate attention is paid to heat treatment. (auth)

5964 (LA-6092-MS) THERMAL CONDUCTIVITY OF URANIUM: EFFECTS OF PURITY AND MICROSTRUCTURE. Sandenaw, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1975. Contract W-7405-Eng-36. 8p. Dep. NTIS $4.00.

Thermal conductivity curves for polycrystalline uranium are presented for the temperature range below 373°K. The curves are for specimens prepared by different fabrication procedures from material of known purity and hardness. Included is a curve for U/2wt percent Mo alloy. Different mechanisms appear to be influencing the thermal conductivity behavior of uranium in well-defined temperature regions: below 37 to 43°K, approximately 40 to approximately 80°K, 80 to approximately 280°K, and from 280°K to the alpha yields beta transformation temperature. Mechanisms responsible for results in one temperature region continue to exert a strong influence in the next higher temperature region. Impurities and initial microstructure seem to influence results at any starting temperature. Evidence is presented for the possibility of imperfection ordering in uranium between approximately 40 and approximately 280°K. It is postulated that the type of ordering is capable with a martensite-like behavior and that all physical property results depend on the extent of a modification of the alpha-phase on cooling below approximately 280°K. (auth)

5965 (LBL-4152) Fe-12Ni-4Co-2Mo-.05Ti ALLOY FOR USE AT 77°K AND BELOW. Whitaker, B. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 65p. Dep. NTIS $5.50.

Thesis.

A variant of the maraging class of steels is proposed for application at 77°K and below where a combination of very high strength and good toughness is required. The alloy has a composition of Fe-12Ni-4Co-2Mo-0.05Ti where low interstitial content. The as quenched and quenched and aged structures were completely martensitic with a prior austenitic grain size of 10 to 12 mu m. This structure had a Y.S. of 138.5 ksi and 154 ksi before and after aging respectively. All aging was done at 444°C for 4 hours. The DBTT was shown to lie above 77°K as measured by C/sub v/ testing. Based on dilatometric studies of the alpha yields gamma and gamma yields alpha transformation temperatures a cycling treatment consisting of reportedly heating to above the A/sub f/ temperature followed by a water quench was utilized to further reduce the prior gamma grain size to approximately 4 to 6 mu m. The structure was completely martensitic and possessed a Y.S. of 151 ksi at 77°K in the unaged condition with a Y.S./K/sub IC/ ratio of 1.9 while the aged structure showed a Y.S. of 162 ksi with a Y.S./K/sub IC/ ratio of 1.3. C/sub v/ testing showed the DBTT to lie between 77°K and 4.2°K. Further grain refinement was accomplished by a 2 phase decomposition procedure which resulted in a grain size of 1 to 2 mu m. The structure which contained decreasing amounts of austenite with temperature (3.0 percent at R.T. to 1.0 percent at 4.2°K) showed the best combination of strength and ductility at 4.2°K. A Y.S. of 205 ksi with a Y.S./K/sub IC/ ratio of 0.84 was achieved before aging. The aged structure was brittle at 4.2°K with a Y.S. of 218 ksi and a Y.S./K/sub IC/ ratio of 0.425. (auth)

5966 (ORNL-tr--4043) CREEP-RUPTURE PROPERTIES OF HASTELLOY-X USED AS STRUCTURAL COMPONENT IN OGL-1. Yokoi, S.; Monma, Y.; Fujimura, T.; Kikuyama, T.; Itami, K. (Japan Atomic Energy Research Inst., Tokyo). 12 Feb 1974. Translation by H. Kubota of JAERI-M--5651. 12p. Dep. NTIS $4.50.

Creep rupture tests were conducted on Hastelloy-X that is the material used for the inner wall tubes of the OGL-1 on the forged base material at 800, 900, and 1000°C and on the electron beam and TIG welded material at 900 and 1000°C, and the following results were obtained: (1) The stress-rupture time relationship for the forged base material was a linear relationship on a log-log plot for all three temperatures. (2) Rupture time of the electron beam weld material was of the same order as that of the base material at both 900 and 1000°C. (3) Rupture time of TIG weld material at 900°C was about the same as that of the base material, but this material ruptured at ½-⅓ the time of the base material at 1000°C. (4) Deformation and rupture modes of the base material were such that localized reduction in area was large to the low-temperature high-stress side, and the intragrain rupture was accompanied by cavity type microcracks. On the other hand, localized reduction in area was virtually nonexistent to the high-temperature low-stress side, and grain-boundary rupture due to wedge-shaped microcracks took place. (5) Rupture in TIG weld material at 1000°C took place through microcracks that formed along the Mo compounds precipitating continuously as large particles at the crystal grain boundaries of the welded metal. (6) The precipitate in the base material to the low temperature high stress side was Mo compounds distributed in uniform and minute manner within the grains, but it was a large Cr-Mo composite compound distributed along the grain boundary to the high temperature low stress side. (7) Large Mo compound precipitate deposited rapidly along the grain boundary of the welded metal of the TIG weld material at 1000°C as a result of which a Mo deficient layer was formed in the base about the precipitate, and this formation weakens the solid solution reinforcement of the base. This behavior is thought to be one factor responsible for the short-term rupture. (auth)

5967 COMPOSITION OF EXCESS PHASES IN CAST HEAT RESISTANT Ni-Cr ALLOYS. Bakanova, T. P.; Kostogonov, V. G.; Faivilevich, G. A.; Shcherbedinskii, G. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 360-362(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 75-78(Apr 1975).

Heat tinting revealed the complex and irregular composition of excess phases (blue carbides, yellow-orange nitrides) with distinct boundaries of separation. Microprobe analysis showed that the yellow-orange particles contain Ti and N, while blue particles consist mainly of Nb and C. The presence of other carbide-forming elements (Ti and Mo) in niobium carbide and the small amount of nitrogen and oxygen lead to the assumption that the niobium carbide is of complex composition (oxycarbonitride). (auth)

5968 EFFECT OF CARBON ON STRUCTURE AND PLASTICITY OF BETA TITANIUM ALLOYS. Kolachev, B. A.; Mal'kov, A. V.; Sedov, V. I. (Moscow Aviation Technology Inst.). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 226-228 (1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 42-43(Mar 1975).

Particles of titanium carbide were observed in the β titanium alloy (10 Mo-6 Zr-4Sn) with 0.1% C. The precipitation of titanium carbide lowers the impact strength, increases susceptibility to brittle fracture, and impairs the plasticity of the alloy. It is expedient to reduce the permissible concentration of carbon in alloys with mechanically stable β phase (it should not exceed 0.05% in wrought alloys). (auth)

5969 STRUCTURE AND ELASTIC CHARACTERISTICS OF Nb-Ti ALLOYS. Vasil'eva, E. V.; Gorbova, A. S.; Prokoshkin, D. A. (Moscow Technical Coll.). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 267-268(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 73-74(Mar 1975).

The effect of Ti (0 and 1 to 60%) on the elastic limit $\sigma_{0.003}$, elastic modulus, and microhardness of Nb was determined after cold deformation and after annealing. The elastic limit is highest for the alloy with 25% Ti. (DLC)

5970 GALVANOMAGNETIC PROPERTIES OF VANADIUM CARBIDE. Shacklette, L. W.; Ashworth, H. A. (Seton Hall Univ., South Orange, NJ). Phys. Rev., B; 12: No. 4, 1146-1153 (15 Aug 1975).

Measurements of the magnetoresistance of vanadium carbide were made as a function of carbon concentration and temperature. For well-ordered samples the results for rho_{1111}, rho_{1122}, and rho_{1212} are analyzed along with previously taken data for the Hall effect and electrical resistivity. Results of the measurements indicate that an appropriate electronic band structure must include at least two anisotropic (nonspherical) bands for carriers of opposite sign. Comparisons are made to density-of-states data derived from specific-heat measurements and band-structure calculations. (auth)

5971 HEAT TREATMENT OF CAST TUNGSTEN ALLOYS. Savitskii, E. M.; Povarova, K. B.; Shegai, A. A.; Postnov, L. M.; Makarov, P. V.; Popov, A. P. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 291-294(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 17-20(Apr 1975).

Effects of heat treatment (heating temperature) on the structure of tungsten alloys were examined for three groups: solid solutions based on tungsten, alloys containing secondary carbides (W_2C or MC) along with the solid solution, and alloys containing eutectics. An optimal structure (finely dispersed and evenly distributed carbide precipitates of the MC type) of cast alloys based on tungsten containing carbide phase can be obtained by alloying such that the composition in a given temperature range corresponds to regions W + MC or W + W_2C + MC on ternary or more complex phase diagrams. It is preferable if the alloying elements permit slag remelting with subsequent rapid cooling. For cast VAR and EBR alloys with large grains and large carbide particles, heat treatment above 2500°C, followed by deformation at lower temperatures, is recommended. (auth)

5972 HOT BRITTLENESS OF Mo + 30% W. Ababkov, V. T.; Morgunova, N. N.; Gulyaeva, T. V. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 295-298(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 21-24(Apr 1975).

The alloy of Mo-30% W is susceptible to hot brittleness at 1400-1800°C. Varying the tungsten content from 28 to 35% has little effect on the susceptibility to hot brittleness. Raising the carbon content from 0.002 to 0.007% sharply reduces the reduction in section in the hot brittleness range. The addition of a small amount of hafnium (~0.2%) to the Mo + 30% W alloy reduces susceptibility to hot brittleness. Increasing the strain rate within the limits of 0.5-3000 mm/min reduces susceptibility to hot brittleness. The hot brittleness of the alloy is due to precipitation of phase of the Mo_2C type in the grain boundaries. (auth)

5973 PROPERTIES OF TUNGSTEN ALLOYS WITH CARBON, NIOBIUM, TANTALUM, AND ZIRCONIUM. Pod'yachev, V. N.; Gavrilyuk, M. I. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 299-302(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 24-28(Apr 1975).

Alloying of tungsten and W-C alloys with zirconium, niobium, and tantalum increases the short-term and also the long-term strength. The strength is increased most by small additions of the alloying element (up to 0.1 at. %). In effectiveness of hardening at temperatures $\leq 0.6T_m$, the elements investigated are arranged in the following order: Zr, Nb, Ta. At temperatures $\geq 0.6T_m$, separate and combined alloying of tungsten with carbon and substitutional elements of groups IV and V does not improve the heat resistance. Alloying elements raise the ductile-brittle transition temperature T_x of tungsten and W-C alloys. The increase of T_x is highest with the addition of Zr. (auth)

5974 CREEP OF LOW-ALLOY MOLYBDENUM ALLOYS. Vinogradov, N. I.; Ermishkin, V. A.; Fridman, Z. G. (Inst. of Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 303-304(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 28-29(Apr 1975).

Alloying with B, La, Ta, B_4C, and Hf was investigated and the creep strength at 1700°C determined. The creep strength was found to be increased by the alloying. (DLC)

5975 STRUCTURAL TRANSFORMATIONS DURING AGING OF ALPHA TITANIUM ALLOYS. Parshin, A. M.; Razuvaeva, I. N.; Ushkov, S. S.; Shibalova, L. I. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 309-312(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 4, 33-36(Apr 1975).

The toughness of the alloy VT6 alloyed with 6% Zr decreases substantially with aging at 400 to 600°C. The main reason for the lower toughness after aging is decomposition of the small amount of β phase that inevitably exists in semifinished products of α titanium alloys. The presence of β phase is due to the characteristics of the polymorphous $\beta \rightarrow \alpha$ transformation with relatively slow cooling of the metal in the $\alpha + \beta$ region. (auth)

5976 STABILITY OF THE POLYGONAL STRUCTURE IN RELATION TO CARBIDE AND INTERMETALLIC PHASES. Lanskaya, K. A.; Kamenskaya, N. I. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 185-187(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 2-4(Mar 1975).

Effect of mechanicothermal treatment is larger in austenitic steels (2 and 8% W) with intermetallic hardening phases, since the polygonal structure obtained in these steels is more stable than in steels hardened with carbides. It is expedient to harden these steels with both carbide and intermetallic phases, alternating in the process of precipitation. The temperature of deformation in MTT must be selected so that the temperature range where the polygonal structure is formed is below the temperature range where the main hardening phase coalesces. (auth)

5977 EFFECT OF ADSORPTION OF ALLOYING ELEMENTS ON THE MORPHOLOGY OF PRECIPITATES IN Ni-Cr-Nb ALLOYS. Khovova, O. M.; Geveling, N. N.; Rakhshtadt, A. G. (Moscow Technical Coll.). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 191-196(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 8-13(Mar 1975).

T-T-T diagrams were plotted for Ni-Cr-Nb alloys (multicomponent commercial alloy 70NKhBMYu and the basic ternary alloy N70Kh20B9) that show the change in the morphology of second phases precipitated during aging. The aging conditions were determined for obtaining a lamellar structure of discontinuous decomposition throughout the bulk of alloys 70NKhBMYu (930-900°C for 1-2 h) and N70Kh20B9 (880-750°C for 1-8 h). The structure and morphology of second phases precipitated during aging of Ni-Cr-Nb alloys are affected by the character of adsorption of the element added. The mechanism of the effect of aluminum, tungsten, and molybdenum in Ni-Cr-Nb alloys on the morphological sequence of precipitation of excess phases is correlated with the effect of these elements on the stability of dispersed phases and the surface energy of the interphase boundaries. (auth)

5978 EFFECT OF ALLOYING ELEMENTS ON PLASTICITY OF Cr-Ni ALLOYS WITH Nb AT HIGH TEMPERATURES. Stepanov, V. P.; Bulavina, L. S.; Tsvetkova, V. K. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 197-199(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 13-16(Mar 1975).

To ensure the necessary plasticity of alloy KhN50MBVYu, the total concentration of alloying elements (Cr, W, Mo, Nb, Fe, Al, Zr) should be moderate (in the middle of the range investigated). A high concentration of any single element is permissible if the concentrations of the other elements are lowered, since all the alloying elements lower the technological plasticity of the alloy. (auth)

5979 EFFECT OF SOLUTIONING TEMPERATURE ON THE STRUCTURE OF CAST HEAT RESISTANT NICKEL-BASE ALLOY. Nagin, A. S.; Gadalov, V. N.; Novichkov, P. V.; Trigub, V. B. (Voronezh Polytechnical Inst., USSR). Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 3-4, 204-206(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 3, 20-23(Mar 1975).

The alloy composition was 19.4% Cr, 8.74% Fe, 4.98% Mo, 2.72% Ti, 1.5% Al, balance Ni. Electron microscopy, microprobe analysis, and low-frequency internal friction were used. It is concluded that, for reduced segregation and improved distribution of the hardening γ'-phase, the solution treatment should be carried out at 1200°C. (DLC)

5980 SUPERCONDUCTING PROPERTIES AND THE STRUCTURE OF SOME BINARY RARE-EARTH-METAL SYSTEMS WITH GROUP IV AND V TRANSITION METALS AND LEAD. Savitskii, E. M.; Efimov, Yu. V. pp 310-316 of Redkozmel'n. Met., Splavi i Soedineniya'. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Phase diagrams and superconductivity transition temperature, T_c, were determined for some binary systems of rare-earth metals (REM) with V, Nb, Ti, Zr, and Pb. Films 4000 to 10,000 Å thick and bulk specimens were used. The REM–V diagrams, apart from Sc–V, show limited solubility in the solid and liquid states. There is a marked reduction in T_c of V when alloyed with REM of the Ce sub-group, no change with the Y sub-group, and an increase in T_c with Sc additions. In the Nb–Sc, Nb–La, and Nb–Sm systems the REM have practically no effect on T_c, but Ce in Nb reduces T_c to 8.8°K. Neither film nor bulk specimens of Ti–Sm or Zr–Sm alloys or the seven La–Pb compounds show superconducting properties above 4.2°K, although $SmPb_2$ is superconducting with T_c = 6.5°K. (Metals Abstr.)

5981 NONDESTRUCTIVE TESTING OF BERYLLIUM. Runck, R. J. Columbus, OH; Battelle Columbus Laboratories (1974). 76p. (MCIC–74-22).

The nondestructive tests useful in evaluating Be are identified. Special modifications in some of the tests necessary for their application to Be are described. Methods discussed include: radiography for detecting inclusions and voids; liquid-penetrant tests for surface imperfections; ultrasonic and eddy-current tests for near-surface discontinuities; acoustic emission for evaluating Be under load; and holographic interferometry to detect strain, thereby identifying debonds in Be structures. There is an urgent need for a nondestructive method for evaluating the surface condition of fabricated Be. (Metals Abstr.)

5982 RECOVERY PHENOMENA OF THE COLD WORKED PURE ZIRCONIUM. Jung, D. Y.; Yoon, J. K. (Seoul National Univ.). J. Korean Nucl. Soc.; 7: No. 1, 15-23(Mar 1975).

Recovery behavior of cold compressed pure zirconium was investigated by the measurement of x-ray line breadth and microhardness. By isochronal annealing, it was found that both hardness and x-ray line breadth do not decrease much below 300°C. It was also found that at the same degree of cold work, the rate of recovery of x-ray line breadth is different from that of hardness, and that regardless of cold working degrees, activation energy for the recovery of x-ray line breadth is less than that of hardness. The activation energies for recovery of x-ray line breadth in 8, 19, and 28% cold-worked zirconium were 64.8, 56.4, and 48.5 kcal/g-atom, respectively, and those of hardness were 72.8, 64.3, and 58.6 kcal/g-atom, respectively. (auth)

5983 RESISTANCE OF INDIUM IN THE INTERMEDIATE STATE INVOLVING A NONUNIFORM CONCENTRATION OF THE NORMAL PHASE. Krylov, I. P. (Inst. of Physics Problems, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1557-1568(Apr 1975). (In Russian)

An increase of the resistance of high-purity indium single crystals in the intermediate state is observed if a nonuniform concentration of the normal phase is produced. The dependence of the effect on magnitude of concentration inhomogeneity introduced, on temperature and other factors is investigated. The experimental results are in agreement with theoretical calculations based on the equations of macroscopic electrodynamics of the intermediate state. The phenomenon observed can be ascribed to the Hall effect and the «hydrodynamic» properties of the flow of normal and superconducting domains. By its nature the phenomenon resembles the resonant growth of wave resistance theoretically predicted by Andreyev. (auth)

5984 EXPERIMENTAL INVESTIGATION OF THE NONEQUILIBRIUM STATE OF SUPERCONDUCTORS EXCITED BY LASERS. Golovashkin, A. I.; Mitsen, K. V.; Motulevich, G. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1408-1412(Apr 1975). (In Russian)

The superconducting properties of Pb and Nb_3Sn films irradiated by pulsed laser radiation are studied. A GaAs laser with pulse intensities up to 50 W and pulse durations between 0.1 and 10 μs was employed. The dependence of the signal (related to the appearance of a resistance) on sample temperature and intensity and duration of the laser pulse is investigated. A spatially nonuniform distribution of excitations is observed. The phenomenon resembles the formation of Keldysh exciton drops in semiconductors. (auth)

5985 CRITICAL MAGNETIC FIELDS FOR SUPERCONDUCTING TECHNETIUM FILMS. Teplov, A. A.; Mikheeva, M. N.; Golyanov, V. M. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 3, 1108-1116(Mar 1975). (In Russian)

Critical magnetic fields perpendicular and parallel to the film surface and the specific resistances are measured for 55 to 1600 Å thick technetium films. The relation between these quantities and sample structure is investigated. Variation of the electron density of states on transition to a thin-film face-centered cubic modification is assessed. (auth)

5986 DYNAMIC PROPERTIES OF FINITE LENGTH SUPERCONDUCTING FILAMENTS. Likharev, K. K.; Yakobson, L. A. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 3, 1150-1160(Mar 1975). (In Russian)

The dynamic properties of quasi-one-dimensional superconductors of finite length, viz. their volt-ampere characteristic (VAC) and Josephson effect, are calculated by a simple extension of the Ginzburg–Landau equations. It is shown that in most cases simple boundary conditions on the modulus of the order parameter can be employed to describe such superconducting «filaments». For large current values the VAC tends to a straight line $\overline{V} = JR_N - \Delta V$ where the quantity ΔV is independent of the material and filament length. Moreover, for short filaments the upper frequency boundary of the Josephson effect is found as well as the magnitude of the interference current component which is proportional to $(-V \cos \varphi)$. Available experimental data are discussed and it is shown that a quantitative verification of the effects considered should be possible with the variable–thickness bridges developed recently. (auth)

5987 THERMOPHYSICAL AND MAGNETIC PROPERTIES OF TECHNETIUM OVER A WIDE INTERVAL OF TEMPERATURES. Spitsyn, V. I.; Zinov'ev, V. E.; Gel'd, P. V.; Balakhovskii, O. A. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 221: No. 1, 145-148(1975). (In Russian)

The electric conductivity, thermal diffusivity, heat capacity, magnetic susceptibility, thermal-emf, and thermal conductivity of metallic technetium in the temperature interval from 80 to 1800°K were measured. Cast technetium was prepared by pressing and then rolling to a thickness of 0.25 mm with ~15% reduction per pass. Rolling was alternated with intermediate, vacuum annealings of the metal at 1300°C. Technetium wire was also prepared by drawing with intermediate annealings at 1000°C after each 10% reduction. The metal contained about 0.08 wt % impurities, and had a density of 11.49 g/cm³ at 300°K. The data on the thermophysical and magnetic properties of technetium over a wide range of temperatures indicate a possible change in the topology of the Fermi surface at high temperatures. (SJR)

5988 TEXTURES IN REFRACTORY METALS OBTAINED BY CRYSTALLIZATION FROM THE GASEOUS PHASE. Nechiporenko, E. P.; Krivoruchko, V. M.; Sagalovich, V. V. pp 393-406 of Inorganic and Organosilicate Coatings. Leningrad; Izdatel'stvo Nauka (1975). (In Russian)

From all-union conference on heat resistant coatings; Leningrad, USSR (20 Mar 1973).

A review is given of the regularities in the formation of textured layers of Mo, W, Ta, and Nb during hydrogen reduction and thermal decomposition of the chlorides, fluorides, and carbonyls of these metals. The effect of different parameters (temperature, pressure, composition of the gaseous mixture, and thickness of the layer) on the formation and stability at high temperature of the (100), (110), and (111) structures was examined. The emission characteristics of these metals were determined. (tr-auth)

5989 COALESCENCE OF HARDENER PARTICLES IN DISPERSION-HARDENED ALLOY Ni–3 WT % HfO_2 DURING HIGH-TEMPERATURE CREEP. Babich, B. N.; Bushnev, L. S.; Kolobov, Yu. R. (Tomsk State Univ., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 141-143(1975). (In Russian).

The coalescence of HfO_2 particles during high-temperature creep and annealing was studied by metallography, electron microscopy on replicas, and transmission electron microscopy. The results obtained showed that the drag of the HfO_2 particles by the migrating boundaries is probably the basic mechanism for the combination of the particles under these conditions. The

development of this mechanism, although it is local, has significant consequences. Close to the boundary zones free from particles are formed and plastic deformation occurs in these sites. This causes the appearance of pores and the growth of cracks leading to disintegration. (JSR)

5990 EMBRITTLEMENT OF THE WELD HEAT-AFFECTED ZONE IN A Mn–Cr–Mo–V STEEL. Ritter, J. C.; McPherson, R. Met. Technol.; 1: No. 11, 506-511(Nov 1974).

A fracture-mechanics approach, involving high-temperature fracture toughness tests, is used to investigate embrittlement during post-weld heat treatment in a low-alloy Mn–Cr–Mo–V steel. A large decrease in the fracture toughness of the coarse-grained heat-affected zone occurs upon heating to 600°C, and coincides with the temperature range for reheat cracking. The very low fracture toughness (K_{Ic} = 32 MN/m$^{3/2}$) is due to severe embrittlement of the prior austenite grain boundaries, which is shown to be similar to temper embrittlement. Exposed crack faces consist of grain-boundary facets, devoid of evidence of creep rupture. This kind of fracture is found in cases of severe reheat cracking, and differs from the grain-boundary creep rupture mode otherwise observed. It is proposed that fracture occurs by unstable extension of pre-existing defects under the action of residual welding stresses, and follows the embrittled grain-boundary network. (Metals Abstr.)

5991 OPTICAL PROPERTIES OF Ti, Zr, AND Hf FROM 0.15 TO 30 eV. Lunch, D. W. (Ames Lab., IA); Olson, C. G.; Weaver, J. H. Phys. Rev. Lett.; 11: No. 10, 3617-3624(15 May 1975).

The absorptivity or reflectivity of polycrystalline samples of Ti, Zr, and Hf was measured from 0.15 to approximately 30 eV. The data were Kramers-Kronig analyzed to determine the dielectric functions. Between approximately 0.2 and approximately 7 eV, each metal showed five structures in the absorptivity and epsilon$_2$. These were interpreted as interband transitions within the d bands. The epsilon$_2$ spectra had minima near 7 eV similar to that observed in the bcc transition metals. Additional structures at higher energy could be related to transitions involving highlying bands and the core levels. The electron-energy-loss functions were calculated and discussed in terms of volume and surface plasmons. These metals, like the other transition metals studied, exhibited two volume and two surface plasmons. (14 fig, 3 tables, 32 references) (auth)

5992 BAND-STRUCTURE EFFECTS IN FIELD-EMISSION ENERGY DISTRIBUTIONS IN TUNGSTEN. Nicolaou, N.; Modinos, A. (Univ. of Salford, Eng.). Phys. Rev. Lett.; 11: No. 10, 3687-3696(15 May 1975).

A calculation of the total energy distribution of field-emitted electrons from the (100) and (110) planes of tungsten is presented. The potential inside the metal is represented by a superposition of atomic potentials in the muffin-tin approximation as evaluated by Mattheiss. The crystal is terminated abruptly at the surface and the potential barrier outside the surface is represented by a straight line. Using the mathematical apparatus developed by low-energy-electron-diffraction theorists, the band structure of tungsten is reproduced and the tunneling probability calculated by matching the wave function outside the metal to a superposition of Bloch waves, including a number of evanescent waves, inside the metal. The total energy distribution from the (100) plane exhibits a sharp peak at 0.29 eV below the Fermi level which suggests that the experimentally observed hump at about the same energy is due to band-structure effects. It is shown that this peak in the total-energy-distribution curve is due to electron states associated with certain sections of the constant-energy surface and it is argued that spin-orbit interaction is not likely to remove this peak. The calculated distribution from the (110) plane does not show any marked deviation from the free-electron behavior in agreement with the experimental observations. For the (100) plane the ratio of the exact total energy distribution to its corresponding value evaluated in the free-electron approximation for the (100) plane is considerably smaller than unity away from the peak in the total-energy-distribution curve. For the (110) plane it is of the order of unity. (auth)

5993 COPPER DIFFUSION IN SINGLE-CRYSTAL ALPHA-Zr. Hood, G. M.; Schultz, R. J. Chalk River Nuclear Lab., Ontario, CA (Hood, G. M.; Schultz, R. J.). Phys. Rev. Lett.; 11: No. 10, 3780-3784(15 May 1975).

Tracer diffusion of ^{64}Cu in alpha-Zr single crystals was measured in the temperature range (615–860)°C. The temperature dependences of the ^{64}Cu diffusion coefficients in directions parallel to and perpendicular to the c axis are given by D/sub parallel/ equals 0.40e/sup -1.54 eV/kT/ and D/sub perpendicular to/ equals 0.25e/sup -1.60 eV/kT/ cm^2/s, respectively. Results are discussed in terms of an interstitial diffusion mechanism. (auth)

5994 DISPERSION OF NONLINEAR OPTICAL SUSCEPTIBILITIES OF InAs, InSb, AND GaAs IN THE VISIBLE REGION. Bethune, D.; Schmidt, A. J.; Shen, Y. R. (Univ. of California, Berkeley). Phys. Rev. Lett.; 11: No. 10, 3867-3875(15 May 1975).

The dispersion of parallel chi/sup (2)/(2 omega) parallel for the III-V semiconductors InAs, InSb, and GaAs at 80 and 300°K was measured, with h omega between 2.0 and 2.7 eV. Large dispersion in parallel chi/sup (2)/(2 omega) parallel is found for all three semiconductors, while the results for the two temperatures are similar. The observed structures in chi/sup (2)/ are compared with those in chi/sup (1)/(omega) and chi/sup (1)/(2 omega), and Miller's DELTA derived from the experimental values. The measured chi/sup (2)/(2 omega) is also compared with recent theoretical results obtained from empirical pseudopotential calculations. (8 fig, 36 references) (auth)

5995 PHOTORECORDING DEVICE FOR STUDYING ORIENTATIONAL EFFECTS IN THE CHANNELING OF PROTONS. Arkhipovich, V. A.; Kolyada, V. M.; Denisov, V. G. (All-Union Scientific-Research Inst. of Analytical Instrument-Making, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 585 (1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 202-204(1975).

A photoelectric device intended for reading information from a scintillation screen is described. The circuit of the electronic tract is given together with the channeling curves of protons in molybdenum obtained with aid of this instrument. (auth)

5996 RECRYSTALLIZATION OF BERYLLIUM SUBJECTED TO HYDROSTATIC EXTRUSION. Kornienko, P. A.; Nikolaenko, A. A.; Taranenko, I. A. Met. Sci. Heat Treat. (USSR) (Eng. Transl.); 17: No. 1-2, 56-60(1975).

Translated from Metalloved. Term. Obrab. Metal.; 17: No. 1, 53-57(Jan 1975).

The effective activation energy of primary recrystallization (46 ± 4 kcal/g-atom) and grain growth (51 ± 4 kcal/g-atom) in Be was determined for all degrees of deformation. The average rate of grain growth at different stages of recrystallization was determined. The increase in the rate of grain growth with increasing degrees of deformation is due to the formation of a larger number of cells with increasing numbers of defects in them. The recrystallization process occurs at a higher rate in extruded beryllium than in rolled beryllium due to the larger accumulated energy and the larger number of defects. (auth)

5997 SIMPLE SHELL MODEL APPROACH TO LATTICE DYNAMICS OF Cr, Mo, AND W. Kim, C. H.; Chang, J. H. (Seoul National Univ.). J. Korean Nucl. Soc.; 7: No. 2, 107-118 (Jun 1975).

The lattice dynamics of Cr, Mo, and W are formulated in terms of a simple shell model in which the transition metal ions in the crystals are treated as deformable ions. The model involves a total of seven parameters; two charge parameters and five force constant parameters. The numerical values of the model parameters are determined by fitting to three elastic constants and the lattice vibrational frequencies measured by the neutron inelastic scattering experiments. Attempts are made to compute the phonon dispersion relations, the frequency distribution functions, and the lattice specific heats of three metals. The results are compared with experiments. It is found that the simple shell model can give a satisfactory account for the lattice vibrational characteristics of transition metals. The usefulness of the model is then discussed in comparison with other lattice dynamical models. (auth)

5998 STRUCTURE OF LIQUID Pb–Bi ALLOYS BY X-RAY DIFFRACTION. Waseda, Y.; Yokoyama, K.; Suzuki, K. (Tohoku Univ., Sendai). Phys. Chem. Liq.; 4: No. 4, 267-278(1975).

X-ray diffraction measurements were made at temperatures about 50°C above liquidus in the Pb–Bi system. Three partial structure factors $S_{ij}(Q)$ were evaluated from the observed x-ray intensities assuming that each $S_{ij}(Q)$ is independent on the relative abundance of the constituent elements in the alloys. The partial reduced distribution functions $G_{ij}(r)$ were also calculated. The functions $S_{ij}(Q)$ and $G_{ij}(r)$ have maxima which lie between those of the pure elements. The radii of the first coordination sphere show a linear dependence on the concentration as expected from random distribution of the atoms in liquid Pb–Bi alloys. A comparison was made between the partial and total structure factors obtained in this work and those calculated from the hard sphere model. Adequate agreement was obtained on the first peak, but good agreement of the damping behavior and phase was not necessarily found. (auth)

5999 FURTHER JUSTIFICATION FOR THE CONCEPT OF A PERCUS–YEVICK TEMPERATURE IN LIQUID METALS. Siegel, E. (General Motors Technical Center, Warren, MI). Phys. Chem. Liq.; 4: No. 4, 205-209(1975).

In justification of the Percus-Yevick [Phys. Rev., 110:1(1958)] temperature concept in liquid metals it is noted that its use to characterize the liquid phonon frequency spectrum in liquid metals is a valid approach. It gives fair agreement with Mott's theory of liquid metals and solid metal resistivity ratios at melting temperatures. (JRD)

6000 MODELS FOR THE EFFECT OF CHEMISORBED GASES ON THE ELECTRICAL RESISTANCE OF METAL FILMS. Surplice, N. A.; Mueller, J.; Singh, B. (Univ. of Keele, Staffs, Eng.). Thin Solid Films; 28: No. 2, 179-187(Aug 1975).

Three hypotheses are considered for the proportionate change of resistance $\Delta R/R_1$ when a continuous metal film of resistance R_1 adsorbs gas: (a) a loss of metallic properties at the surface; (b) a change in the electron scattering parameter at the surface; and (c) a change in the electron concentration throughout the film. Two models of the film structure are used to compare the predictions of these hypotheses with experimental data for the systems O_2/Er, CO/Er, CO/Ti and O_2/Ti. The flat plate model accounts for neither R_1 nor $\Delta R/R_1$. A simple version of the columnar model accounts for $\Delta R/R_1$ by either (a) or (b) for the first three systems and by (c) for the fourth, but it does not explain all the properties of the clean films. The linear approximation given by Mola and Heras for the columnar model of Mayadas and Shatzkes accounts satisfactorily for R_1 and $\Delta R/R_1$ for O_2/Er, CO/Er and CO/Ti by increases in the electron scattering coefficient at the grain boundaries. It does not account for $\Delta R/R_1$ with O_2/Ti because that system incorporates gas into the metal lattice. (auth)

6001 INTERDIFFUSION IN Pb–IN THIN FILM COUPLES. Lahiri, S. K. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). Thin Solid Films; 28: No. 2, 279-281(Aug 1975).

Interdiffusion in Pb–In thin film couples has been examined by an x-ray diffraction technique. Initial results indicate that the interdiffusion in such couples is significantly faster than that expected from reported bulk data. (auth)

6002 CHARACTERIZATION OF EVAPORATED GOLD–INDIUM FILMS ON SEMICONDUCTORS. Finstad, T. G.; Andreassen, T.; Olsen, T. (Univ., Oslo). Thin Solid Films; 29: No. 1, 145-154(Sep 1975).

Evaporated Au–In films with total thicknesses in the range 200-6000 Å were studied by backscattering of 1.5-MeV He^+ ions, SEM, X-ray diffraction and with the electron microprobe. Both Si and GaAs were used as substrates, and the atomic percentage of Au in the films was less than 30. A fast diffusion within the films was observed which resulted in the formation of the $AuIn_2$ phase at room temperature. The compositional structure and the annealing behavior of the films were studied in the temperature range 25-600°C. A model for the annealing behavior of the films is presented. The Au–In films have been used for ohmic contacts to GaAs and a correlation between the resistance of such contacts and the alloying behavior is attempted. (auth)

6003 STRUCTURE AND MECHANICAL PROPERTIES OF ZINC–COPPER–TITANIUM–IRON–VANADIUM ALLOYS AFTER PLASTIC DEFORMATION. Piotrowski, W.; Owczarek, M. Zesz. Nauk. Politech. Lodz., Mech.; 37: 115-129(1973). (In Polish)

The role of Fe in Zn–Cu–Ti–Fe–V alloys was investigated in order to evaluate the possibility of producing these alloys using ferrovanadium instead of technical V. Additions of Fe 0.04 to 0.11% have no effect on the macro- and microstructure of Zn–Cu–Ti–V alloys, and Fe can be considered as an alloying element and not an impurity. Zn–Cu–Ti–Fe–V alloys behave well during hot and cold plastic deformation. Their mechanical properties are better or similar to those of Zn–Cu–Ti–V, Zn–Cu–V, and Zn–Cu–Ti. (Metals Abstr.)

6004 INVESTIGATION OF PROXIMITY EFFECT BY ELECTRON TUNNELLING. Chen, T. T.; Kiang, L. L. (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 12: No. 2, 53-60(Oct 1964).

The proximity effect with lead/silver films was studied by use of Al-oxide-Ag/Pb and Al-oxide/Pb/Ag tunnelling junctions. From the tunnelling characteristics, the induced energy gap and the effect of the induced strong coupling in silver film due to lead film were found. Reduction of the energy gap and that of the strong coupling effect in lead film due to silver film are also studied. The energy gap thickness dependence is shown to be in agreement with the McMillan's tunnelling model of the superconducting proximity effect. (auth)

6005 STUDY OF CRACK TIP PLASTIC ZONE TOPOGRAPHY IN BERYLLIUM. Cooper, R. E. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Test. Eval.; 3: No. 2, 87-92(Mar 1975).

Multiple-beam interferometry has been used to study the size and shape of plastic zones both at the tip of subcritical cracks and at the edges of running cracks in rolled ingot and in hot pressed, fully dense and porous beryllium. It is shown that from the zone shape an effective yield stress for the material can be derived and that this stress corresponds to somewhere between the 0.2 percent proof stress and the microyield stress of the material as measured under uniaxial tension. The relevance of this effective yield stress to practical fracture toughness testing is discussed and it is shown that from the points of view of both overall crack tip plastic zone shape and of the effects of plasticity on elastic stress redistribution, the 0.2 percent proof stress is probably the best choice. (auth)

6006 SYSTEM FOR COMPUTER ANALYSIS OF STRESS-STRAIN CURVES. Olshausen, K. D. (Inst. for Atomenergi, Kjeller, Norway); Larsen, J. K. J. Test. Eval.; 3: No. 2, 137-142(Mar 1975).

A system for recording and processing of data obtained in tensile tests is described. The electronics (hardware) consists of signal amplifiers (load and elongation), digital voltmeters with binary code decimal output, serializer, and incremental magnetic tape recorder. The operation sequence is controlled by a system of relays, time delays, and an electronic clock. The computer program calculates not only the typical mechanical properties such as yield stress, ultimate stress, and uniform and total elongation, but also more sophisticated properties such as strain-hardening coefficient and Reed-Hill coefficient, which are difficult to obtain by other means. The computer output is in the form of tabulated data and plotted curves. The system has been used in over 300 tests of Zircaloy and aluminum samples. Most of the tests were done on irradiated ring samples cut from the cladding of boiling water reactor fuel rods, but also tube- and plate-type samples have been tested. There was good agreement between the computer-generated values and the values calculated by conventional methods. (auth)

6007 STRESS RELAXATION IN TENSION OF CA 172 COPPER–BERYLLIUM. Goel, R. P. (Bell Telephone Labs., Inc., Columbus, OH). J. Test. Eval.; 3: No. 1, 62-67(Jan 1975).

Stress relaxation data on commercially available copper-beryllium alloy 172 are presented. Test samples were subjected to strains of up to 2 percent and temperatures from 25 to 181°C. The data show that a high degree of relaxation occurs at higher temperatures and relaxation was found to be independent of the initial stress levels. Time-temperature plots of stress relaxation are presented for designing accelerated relaxation tests on the copper-beryluim alloy tested. The material in the tested condition is generally not used in spring applications and thus results of Austen which compare stress relaxation characteristics of copper-beryllium alloy 172 in the aged and unaged conditions are also presented. (auth)

6008 THERMODYNAMIC PROPERTIES OF LIQUID NEODYMIUM BY LEVITATION CALORIMETRY. Stretz, L. A.; Bautista, R. G. (Ames Lab., IA). Contract W-7405-eng-82. High Temp. Sci.; 7: No. 3, 197-203(Sep 1975).

A rf generator, providing sample levitation and heating, was used in combination with a conventional copper block drop calorimeter to measure the enthalpy of molten neodymium samples. An inert atmosphere (Ar-He mixture) was utilized to prevent sample oxidation and aid in temperature control. Data were fitted by the following equation: H/sub T/ - $H_{298.15}$ equals [44,04 +- 0,38] (T - 1297) + [47,049 +- 251] J/mol for 1446°K less than T less than 2246°K. The maximum estimated error for the heat content is +- 2,5 percent. (DLC)

6009 HEAT CAPACITY AND MAGNETIC SUSCEPTIBILITY OF SINGLE-PHASE ALPHA-CERIUM. Koskimaki, D. C.; Gschneidner, K. A. Jr. (Ames Lab., IA). Phys. Rev., B; 11: No. 11, 4463-4469(1 Jun 1975).

The heat capacity of single-phase alpha-cerium was measured from 1.6 to 22°K and the magnetic susceptibility from 1.6 to 150°K. The electronic-specific-heat constant was found to be 12.8 +- 0.2 mJ (g atom)$^{-1}$ K^{-2} and the Debye temperature at zero degrees was found to be 179 +- 2°K. The susceptibility results show a skewed U type of temperature behavior with minimum of 3.77 x 10^{-6} emu g^{-1} near 50°K and a rapid rise of about 20 percent below 20°K. Results are interpreted according to various models for the nature of alpha-cerium and the alpha reversible gamma transition. (auth)

6010 LOW-TEMPERATURE SPECIFIC HEAT OF $LaAl_2$:Gd IN MAGNETIC FIELDS UP TO 4900 Oe. Trainor, R. J. Jr.; McCollum, D. C. (Univ. of California, Riverside). Phys. Rev., B; 11: No. 9, 3581-3584(1 May 1975).

The specific heat of $LaAl_2$:Gd was measured between 1.3 and 6°K for Gd concentrations of 0, 2.0, 3.0, and 6.0 at. percent in various applied magnetic fields up to 4900 Oe. Broad peaks associated with spin glass transitions in zero field were shifted to

higher temperatures by the applied field. The field dependence of the magnetic specific heat follows a law of corresponding states and exhibits several characteristics predicted by molecular-field theories based on the Ruderman–Kittel–Kasuya–Yosida interaction. For no value of applied field were the results consistent with the absence of magnetic order as suggested by nuclear relaxation measurements. (auth)

6011 STRAIN GAGE METHOD FOR DETERMINING THE MECHANICAL PROPERTIES OF FILAMENTS. Swearengen, J. C.; Ericksen, R. H. (Sandia Labs., Albuquerque, NM). J. Test. Eval.; 2: No. 6, 547-550(Nov 1974).

A test method has been established which permits utilization of strain gages to obtain mechanical properties of filaments. Uniaxial monotonic load-strain and creep measurements were made using several techniques to verify that the method measures properties representative of the filaments. The method eliminates the requirements of obtaining a compliance calibration of the testing machine and has the advantage of facilitating measurements of small strains in filaments having very high stiffness. (auth)

6012 BLENDED POWDERS UPGRADE WEAR RESISTANCE. Ferriss, D. P. (E. I. du Pont Co., Glasgow, DE); Walraedt, J. Int. J. Powder Metall. Powder Technol.; 11: No. 3, 179-186(Jul 1975).

Adding 20 percent or more of a cobalt-based, intermetallic phase alloy to P/M stainless steel or other P/M compositions increases considerably the wear resistance of P/M parts. (auth)

6013 STRUCTURAL MATERIALS FOR NUCLEAR POWER PLANTS. Bush, S. H. (Battelle Pacific Northwest Labs., Richland, WA). J. Test. Eval.; 2: No. 6, 435-462(Nov 1974).

Commercial ferritic and austenitic steels are the predominant materials used in both fossil and nuclear power plants; the significant difference in nuclear plants is the exposure to neutron fluence. Three aspects of material behavior are reviewed: (1) the role of residual elements on radiation damage of steels used for water reactor pressure vessels, (2) influence of neutron-gamma flux and water reactor coolant on stress corrosion, and (3) neutron-induced swelling and void formation in austenitic stainless steels in fast reactors. (auth)

6014 WAVE PROPAGATION IN A CONDENSED MEDIUM WITH N TRANSFORMING PHASES: APPLICATION TO SOLID-I–SOLID-II–LIQUID BISMUTH. Hayes, D. B. (Sandia Labs., Albuquerque, NM). J. Appl. Phys.; 46: No. 8, 3438-3443(Aug 1975).

Constitutive assumptions of local thermal and pressure equilibrium in a mixture of N transforming phases allow construction of a constitutive equation of a generalized Maxwellian form suitable for studying the kinetics of phase transformations induced by shock-wave loading. This equation relates the pressure rate to the strain rate and the phase change rate, the latter being expressed as the time derivative of a vector which has components equal to the mass fractions of the constituent phases. A separate kinetic equation is required for evolution of this composition vector. Coefficients appearing in the constitutive equation depend only on properties that the mixture displays with a frozen composition which in turn depend directly on properties of the pure-phase components of the mixture. The constitutive equation is applied to solid-I–solid-II–liquid bismuth (N equals 3). When wave propagation calculations on bismuth are compared with previous theory and experiments, a lower bound on the melting rate of 4 mu sec^{-1} is found. (auth)

6015 INFLUENCE OF THE CRYSTALLINE FIELD AND KONDO EFFECTS ON THE RELAXATION RATE: APPLICATION TO MOESSBAUER EXPERIMENTS OF YTTERBIUM DILUTED IN GOLD. Gonzalez-Jimenez, F. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Cornut, B.; Coqblin, B. Phys. Rev., B; 11: No. 11, 4674-4682(1 Jun 1975).

Moessbauer experiments show that the relaxation rate of the doublet ground state $GAMMA_7$ in AuYb alloys, divided by the temperature, behaves logarithmically at low temperatures and rises very quickly above 10^0K. This behavior is accounted for by computing the relaxation rate up to third order in the exchange integrals, with a Hamiltonian which describes the resonant scattering of ytterbium impurities and takes into account both spin and orbit exchange scattering and crystalline field effect. (auth)

6016 COEXISTENCE OF SUPERCONDUCTIVITY AND THE KONDO EFFECT IN PbCe AND InCe QUENCH-CONDENSED FILMS. Delfs, R. J.; Beaudry, B. J.; Finnemore, D. K. (Ames Lab., IA). Phys. Rev., B; 11: No. 11, 4212-4218(1 Jun 1975).

Both systems show a Kondo effect and a regular depression of the superconducting transition temperature. Results show that the onset of superconductivity causes major changes in the formation of the Kondo state. (auth)

6017 TUNNELING MEASUREMENTS ON SPIN-PAIRED SUPERCONDUCTORS WITH SPIN-ORBIT SCATTERING. Meservey, R. (Massachusetts Inst. of Tech., Cambridge); Tedrow, P. M.; Bruno, R. C. Phys. Rev., B; 11: No. 11, 4224-4235(1 Jun 1975).

Electron spin effects in superconducting Al films were studied by measuring the conductance of tunnel junctions in a magnetic field. Superconductor–normal-metal tunnel junctions were made with 50-A-thick Al and 500–1000-A-thick Ag films with Al_2O_3 as the barrier. The measured conductance curves were fit by theoretical calculations, which included depairing effects and spin-orbit scattering, and values of the depairing parameter $zeta_0$ and the spin-orbit parameter b_0 were obtained. The relation $zeta_0$ equals zeta(0) + $CH^2/DELTA_0$ was found to describe the (parallel) magnetic field dependence of the depairing. The values of b_0 obtained were independent of H. Superconductor-superconductor tunnel junctions made with two 50-A-thick Al films were studied with various amounts of Ge and Mn impurities. The Ge impurity simply raised T/sub c/, whereas the Mn lowered T/sub c/ and increased b_0. The approximate dependence of b_0 on the Mn impurity concentration was obtained. The qualitative features for spin-orbit scattering predicted by theory were observed, and spin-flip scattering in the tunneling process was shown to be negligible. (17 figures, 46 references) (auth)

6018 MODEL POTENTIAL FOR CHEMISORPTION: H_2 + W(001). McCreery, J. H.; Walken, G. Jr. (Battelle Columbus Labs., OH). J. Chem. Phys.; 63: No. 6, 2340-2349(15 Sep 1975).

A potential function to describe the interaction of a diatomic molecule with a solid surface is formulated as a modified London–Eyring–Polyani–Sato (LEPS) potential. The surface is approximated by a rigid background potential, periodic in the plane of the surface. It is assumed that the individual atom–atom and atom–surface potentials are known and can be reasonably approximated by Morse functions. H_2 + W(001) is presented as an example. One adjustable Sato parameter is introduced and by varying this parameter a wide range of potentials can be generated. The functional form is sufficiently simple so that classical trajectory studies of the reaction dynamics are feasible. Several illustrative trajectories are presented. (auth)

6019 MANIFOLD RESISTIVITY IN THE TRANSITION REGION OF LEAD FILMS. Sugahara, M. (Yokohama National Univ., Japan). pp 114-117 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

On the basis of Ginzburg–Landau theory, the current-induced transition state of superconductors in a longitudinal magnetic field is investigated. Quantization of resistance can possibly occur. The conditions for the appearance of the effect are discussed in comparison with experimental observation on Pb films. (auth)

6020 NORMALIZING CURRENT OF TYPE II SUPERCONDUCTORS IN LONGITUDINAL MAGNETIC FIELDS. Kubota, Y.; Ogasawara, T.; Yasukochi, K. (Nihon Univ., Tokyo). pp 135-136 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The current-carrying capacity of semi-reversible type II superconductor, Nb-50 at.% Ta, is studied in the presence of a stationary longitudinal magnetic field H. As the transport current is introduced, the resistivity begins to increase gradually at the critical current and shows a clear jump from the resistive state to the fully normal state at the normalizing current I_n. The I_n(H) vs. H curve exhibits a maximum at the field $H_m = 0.2\ H_{c2}$ independent of the temperature in the range examined, 4.2 to 5.5°K. The enhancement factor $I_n(H_m)/I_n(0)$ amounts to 1.3 to 1.6. The normalizing current I_n is proportional to the sample radius R, and not to the cross-sectional area. These results are in qualitative agreement with the prediction based on the force free model. However, there is a large discrepancy between theory and experiment in the size of I_n: the calculation gives $I_n(H_m)/5R \cdot H_{c2} = 0.58$, while the observed values are only 14 to 24% of this ideal value. (auth)

6021 HIGH FREQUENCY STUDY OF A SHORT NIOBIUM/LEAD ALLOY LINE. Mazuer, J.; Gilchrist, J. (CNRS, Grenoble, France). pp 293-295 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The resonant Q factors of coaxial lines 1.42 m in length, consisting of fine niobium wires in superconducting tubes were studied. The lines are either open-circuited at each end or else short-circuited at each end. In either case the fundamental resonance and odd harmonics up to the ninth were observed. Various surface treatments of the wire made no appreciable difference to the Q value of the open-circuited lines. The short-circuited lines had much lower Q values due to imperfect short-circuiting contacts, and were used mainly to study the effect of a superposed direct current. This was appreciable even when the current was much smaller than the current that the wire would support without resistive transition. The additional high-frequency loss caused by the current was attributed to flux penetration. (auth)

6022 DEVELOPMENTS ON SUPERCONDUCTING V_3Ga MATERIALS. Tachikawa, K. (National Research Inst. for Metals, Tokyo). pp 322-325 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The superconducting compound V_3Ga has gained much interest because of its large current capacity in high magnetic fields. V_3Ga tapes and multifilamentary wires are now commercially available for winding high field magnets. This article describes the processing and the superconducting properties of the V_3Ga materials developed recently. (auth)

6023 PROCESSING AND PROPERTIES OF SUPERCONDUCTING Nb_3Sn FILAMENTARY WIRES. Hashimoto, Y. (Mitsubishi Electric Corp., Sagamihara, Japan); Yoshizaki, K.; Tanaka, M. pp 332-335 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Nb_3Sn multifilamentary wires were made by a new reliable method, consisting simply of co-reduction and internal diffusion. A critical temperature of 17.6°K and an overall critical current density of 5.4×10^4 A/cm^2 at 80 kG were obtained for a wire suitably prepared. (auth)

6024 SUPERCONDUCTING CURRENT CAPACITIES OF COMPOSITE-PROCESSED LAVES PHASE V/Hf_xZr_{1-x} TAPES. Inoue, K.; Kawamura, H.; Tachikawa, K. (National Research Inst. for Metals, Tokyo). pp 336-338 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

C-15 crystal type Laves phase compounds, $V_2Hf_xZr_{1-x}$, were fabricated into a tape by a composite process in which the Laves phase layers were formed by diffusion between the vanadium sheath and the Hf_xZr_{1-x} alloy core. In the composition range $0.4 \geq x \geq 0.3$, the composite tape showed the maximum values of superconducting transition temperature, upper critical field and critical current density. The critical current of the tape did not degrade by winding into coils with diameters larger than 20 mm. (auth)

6025 INFLUENCE OF FAST NEUTRON AND FISSION DAMAGE ON CRITICAL DATA OF HIGH-FIELD SUPERCONDUCTORS. Bauer, H. (Univ., Giessen, Ger.); Saur, E. J.; Schweitzer, D. G. pp 343-346 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Wire samples of high-field superconductors with A 15 and B 1 structure, some of them doped with small amounts of ^{10}B and ^{235}U, were irradiated at room temperature by fast and thermal neutrons with doses up to 1 x 10^{19} neutrons/cm^2. For samples with A 15 structure the critical currents in transverse fields can be increased up to 460 percent by irradiation. On highly damaged samples drastic reductions in the current-carrying capacity, the critical temperature and indications of a decrease of the upper critical field are found as well as lattice expansions. Superconductors with B 1 structure are much less sensitive to irradiation than A 15 materials. (auth)

6026 EFFECT OF PLASTIC STRAIN AND FILAMENT CONFIGURATION ON CRITICAL CURRENT DENSITY OF Nb–Ti ALLOY WIRES. Koike, Y. (Tokyo Shibaura Electric Co. Ltd.); Kabasawa, R.; Murase, S.; Yoshida, M.; Suzuki, E. pp 347-352 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The critical current density of copper-stabilized multifilamentary Nb–Ti alloy wires was studied in conjunction with plastic deformation. The current-carrying capacity of the cores was found to depend on the location in the wire. The cores at the periphery have higher current-carrying capacity than those at the center. This may be due to higher concentration of [110] fiber structure in the former. Several types of wire with different geometry and configurational arrangements were fabricated to confirm the configurational effect on J_c. (auth)

6027 AVERAGE THERMAL CONDUCTIVITY OF MATERIALS FOR CRYOGENIC STRUCTURAL SUPPORTS. Kawate, Y.; Ooi, T.; Horiuchi, T. (Kobe Steel Ltd., Japan). pp 433-436 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The construction, method of operation, and accuracy of a new and accurate calorimeter suitable for measuring the average thermal conductivities of materials for cryogenic structural supports over wide ranges of temperature are described. The average thermal conductivities between 4.2 to 77, 4.2 to 300 and 77 to 300°K have been measured for Ti alloy, stainless steels, and glass fiber reinforced plastics. (auth)

6028 TENSILE PROPERTIES AND NOTCH TOUGHNESS OF TITANIUM AND Ti–5Al–2.5Sn ELI ALLOY AT CRYOGENIC TEMPERATURES. Sonoi, H.; Nishigaki, M. (Kobe Steel Ltd., Japan). pp 437-438 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The suitability of Ti and Ti–5Al–2.5Sn ELI alloy for structural use at liquid helium temperature was studied. It was found that pure Ti and the ELI alloy have high strength and good notch toughness at 4.2°K. It is noted that in leak-before-burst design pressure vessels, fracture toughness may become more critical. (JRD)

6029 LOW-TEMPERATURE THERMOPHYSICAL AND MECHANICAL PROPERTIES OF HIGH-PURITY PLATINUM-25 WT PERCENT IRIDIUM ALLOY. Foley, R. J. (Univ. of California, Livermore); Jelinek, F. J. pp 443-445 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The low-temperature properties of a platinum-25 wt. percent indium alloy were evaluated in the range from 4 to 300°K. The high-purity material was synthesized by consumable arc melting and subjected to a series of cold-work and aging operations to obtain a high-strength, machinable alloy. Values are presented for the thermal contraction and conductivity between 4 and 300°K. Measurements were performed using fused silica dilatometry and longitudinal steady-state methods. Mechanical strength data are reported at 20 and 300°K. In all cases, the material used was 50 percent cold worked and aged at 973°K for 5 h. (auth)

6030 SUPERCONDUCTIVITY OF $Nb_3Sn_{1-x}Al_x$ COMPOUNDS. Yasukochi, K.; Usui, N.; Akihama, R. (Nihon Univ., Tokyo). pp 473-476 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The upper critical field H_{c2} of $Nb_3Sn_{1-x}Al_x$ compounds was measured by a pulsed and a dc magnet. An H_{c2} (4.2°K) of 270 and 290 kG was obtained for $Nb_3Sn_{0.9}Al_{0.1}$ and $Nb_3Sn_{0.1}Al_{0.9}$, respectively. The data are consistent with the complete suppression of Pauli-paramagnetic limiting. The enhancement of H_{c2} is discussed with respect to the other physical parameters, such as the initial slope $(-dH_{c2}/dT)_{T_c}$, the residual resistivity and the electron specific heat. (auth)

6031 SUPERCONDUCTING THIN FILMS OF β-W TYPE PHASE. Tarutani, Y.; Kudo, M.; Taguchi, S. (Hitachi Ltd., Tokyo). pp 477-480 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Nb–Ga and Nb–Ge thin films have been prepared by a multi-source evaporation method. Preparation conditions were investigated and Nb–Ge thin films of superconducting temperatures above 20°K have been obtained by this method. It was proved from this experiment that the multi-source evaporation method is effective in obtaining non-equilibrium compositions of the β-W type phase. (auth)

6032 CONTROL OF FLUX JUMP IN V_3Ga TAPES BY HIGH PURITY ALUMINIUM SHEET. Ando, T.; Nozawa, Y. (Ulvac Corp., Yokota, Japan). pp 481-484 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The magnetic diffusivity $D_m = 10^9 \rho_{eff}/4\pi$, was measured on stacks of superconducting V_3Ga tapes in combination with various stabilizing materials by observing a magnetization process with the eddy current method. The stacks were exposed to a magnetic field perpendicular to the wide surface of the tape. Without a stabilizing material ρ_{eff} is 6.1×10^{-6} Ω-cm (D_m = 480 cm^2/s) and with high purity aluminium stabilizing ρ_{eff} reaches 9.0×10^{-9} Ω-cm (D_m = 0.72 cm^2/s). When He cooling was applied to 20% of the perimeter of the stack, no flux jump occurred up to 50 kG. (auth)

6033 ALUMINUM STABILIZED Nb–Ti SUPERCONDUCTING WIRES. Murase, S. (Tokyo Shibaura Electric Co. Ltd.); Koike, Y.; Nakayama, Y.; Toyoda, T.; Suzuki, E. pp 485-489 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Aluminum-stabilized 6 to 19 multi-core niobium–titanium superconducting wires were made. These wires were studied in conjunction with critical currents, minimum propagation current, and recovery current. As a result aluminum-stabilized wires are useful at higher magnetic field. (auth)

6034 COMPOSITE FILAMENTARY SUPERCONDUCTORS MADE FROM THE MELT. Olivei, A. (Olivetti SpA, Ivrea, Italy). pp 494-499 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A study was made of the parameters that allow growth from the melt of a composite filamentary material in which the filaments are superconducting and the matrix has high resistivity. From the work done in this area so far, it seems likely that the properties of such composite superconducting materials can be modified significantly by using Mollard-Flemings principles for growing highly directional structures directly from the melt. (auth)

6035 SUPERCONDUCTING COMPOSITES FOR PULSED MAGNETS. Mortis, A. R. (Imperial Metal Industries Ltd., Birmingham, Eng.); Popley, R. A.; Sambrook, D. J.; Walters, C. R.; Wilson, M. N. pp 511-513 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Development of superconducting composites for pulsed superconducting synchrotron magnets is described. As the elementary composites contain increasing numbers of filaments, cupronickel has to be built into the matrix to maintain low ac losses. The cables made from the elementary conductors become simpler as the number of wires is reduced. A 177 241 filament conductor has been made which can be used in a single solid section. (auth)

6036 PHYSICAL METALLURGY AND PROPERTIES OF A NEW CONTROLLED-EXPANSION SUPERALLOY. Muzyka, D. R., Whitney, C. R.; Schlosser, D. K. J. Met.; 27: No. 7, 11-15(Jul 1975).

Studies have revealed a series of high-strength superalloy compositions in which both mechanical and thermal expansion property characteristics can be controlled and varied over wide ranges. One composition, Pyromet CTX-1, is shown to have mechanical properties approximately equivalent to Alloy 718 while showing mean coefficient of thermal expansion approximately half of that of Alloy 718. It should be noted that since Pyromet CTX-1 contains no chromium, it will show substantially less corrosion and oxidation resistance than the usual superalloys. (auth)

6037 ELASTIC MODULUS CORRECTION TERM IN CREEP ACTIVATION ENERGIES: APPLIED TO OXIDE DISPERSION STRENGTHENED SUPERALLOY. Malu, M.; Tien, J. K. (Columbia Univ., New York). Scr. Metall.; 9: No. 10, 1117-1120(Oct 1975).

Creep properties of Inconel alloy MA 753 were studied. It was found that below 1500°F, where elastic modulus is weakly dependent upon temperature, the modulus correction term to creep activation energy is small. Accordingly, for superalloy systems such as INCONEL alloy MA 753 and Mar-M 200, which show high apparent creep activation energies at this temperature, modulus corrections are unimportant and their true activation energies remain high. In contrast, at very high temperatures, as a consequence of the high temperature values and the sharper changes in the slope of the young modulus vs. temperature curve, the elastic modulus correction term can be significant--it is found to be about -142 kcal/mole for INCONEL alloy MA 753 at 1900°F and thus reducing the creep activation energy at this temperature from 202 kcal/mole to that of vacancy self-diffusion. It is noted that in general and especially at high temperatures the creep equation used to analyze creep data and creep activation energies must include the elastic modulus terms. Up to now, the neglect of these terms have by-in-large been justified. However, with the advent of very high temperature creep tests on the high temperature dispersion strengthened systems, the modulus terms must be taken into consideration. With respect to alloy designing for high temperature creep resistance, in addition to other considerations to obtain high temperature creep resistance, a high value of elastic modulus with a weak dependence on temperature at high temperatures is required. (auth)

6038 COMMENTS ON "GORSKY EFFECT MEASUREMENTS OF HYDROGEN DIFFUSION IN NIOBIUM" BY MATUSIEWICZ, BOOKER, KEISER, AND BIRNBAUM. Alefeld, G.; Voelkl, J.; Wipf, H. (Technische Univ., Munich). Scr. Metall.; 9: No. 10, 1095-1096(Oct 1975).

Schaumann et al. [Phys. Stat. Sol. 42: 401(1970)] have reported measurements of the diffusion coefficient of H in Nb by means of the Gorsky effect over the temperature range of -150 to +300°C. In this temperature range a marked change of the slope in an Arrhenius plot from U equals 0.106 eV for T greater than 20°C to U equals 0.068 eV for T less than -50°C has been observed. The high-temperature value has been confirmed by R. Cantelli et al. [Phys. Stat. Sol. 34: 597(1969)]. The change in slope has been reproduced by Wipf and Alefeld [Phys. Stat. Sol. 23: 175(1974)] with a resistivity technique simultaneously showing that the change does not exist for deuterium in niobium. Munzing et al. [Scripta Met. 8: 1327(1974)] report that the low-temperature process disappears gradually on alloying with small amounts of nitrogen. In a recent paper by Matusiewicz et al. [Scripta Met. 8: 1426(1974)] these results concerning the change in activation energy have been questioned on the basis of new Gorsky-effect measurements. It is noted that measurements confined to the transition region are not very likely to reveal a change in slope as a function of temperature. In the transition region the apparent activation energy is an average between the high-temperature and low-temperature value. The apparent activation energy in the transition region increases. (auth)

Radiation Effects

Refer also to abstracts 5556, 6013, 6715, 6725, 6733, and 6864.

6039 (BNWL-SA-5405) EFFECTS OF HYDROSTATIC PRESSURE ON STAGE III RECOVERY IN IRRADIATED AND COLD-WORKED MOLYBDENUM. Kissinger, H. E.; Brimhall, J. L.; Simonen, E. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 8p. (CONF-751006-11). Dep. NTIS $4.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

The Stage III recovery temperature is lowered when irradiated or cold-worked molybdenum is annealed under pressure. In irradiated samples, the pressure effect can be explained in terms of an activation volume, negative in sign, which decreases in magnitude with increasing fluence. For cold-worked molybdenum, the pressure effects are not compatible with the activation volume hypothesis. This suggests that recovery mechanisms for the two types of damage can not be considered identical, the differences probably arising from substructure features characteristic of the damage states. (auth)

6040 (BNWL-SA-5450) EFFECT OF HELIUM ON VOID SWELLING IN VANADIUM. Brimhall, J. L.; Simonen, E. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 5p. (CONF-751101-34). Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Little difference in void microstructural swelling of vanadium is observed when helium is injected simultaneously with a 46- or 5-MeV nickel beam as compared to no helium injection, at least at high dose rates. At lower dose rates, a strong helium effect is seen when the helium is injected prior to heavy ion bombardment. The effect of the helium is shown to be a strong function of the overall displacement damage rate. (DLC)

6041 (CONF-750962-1) RADIATION DAMAGE CONSIDERATIONS. Frost, B. R. T. (Argonne National Lab., Ill. (USA)). Aug 1975. Contract W-31-109-Eng-38. 23p. (CONF-750954-1). Dep. NTIS $4.25.

From colloquium on fundamental aspects of structural alloy design; Seattle, Washington, USA (15 Sep 1975).

The designs of nuclear fission and fusion power plants do not, in general, appear to make unusual demands on materials in terms of mechanical-property requirements. Radiation environments produce unique effects on the composition, microstructure, and defect population of these alloys, resulting in time-dependent and time-independent changes in mechanical properties. To illustrate these problems, the materials needs of the core of a Liquid-Metal Fast-Breeder Reactor (LMFBR) and of the first wall of a fusion reactor are discussed. In the case of the LMFBR core, the phenomenon of void swelling causes serious design problems, and a search is being made for a low-swelling alloy that has adequate mechanical properties. The fusion reactor poses different problems because the neutron energy is high (14 MeV) and is accompanied by a high flux of charged particles. The long-term choices for a wall material have been narrowed to vanadium and niobium alloys. In the search for low-swelling alloys, it has become clear that minor elements play an important role in determining the nature of the radiation effects. The segregation of minor elements to void surfaces and the dispersion and reformation of second-phase precipitates are two important radiation-induced phenomena that require additional study in view of their influence on void swelling and high-temperature properties. (auth)

6042 (CONF-750982-1) EFFECTS OF PRECIPITATION ON ELECTRON DISPLACEMENT DAMAGE IN FCC ALLOYS: COPPER ALLOYS WITH RANDOM AND MODULATED MICROSTRUCTURES. Carpenter, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 4th high voltage electron microscopy conference; Toulouse, France (1 Sep 1975).

Observations on the electron displacement damage behavior of spatially random precipitate in Cu-Co alloys and the modulated structure in Cu-Ti alloys are reported. A few observations of the damage structures in cellularly decomposed Cu-Ti were also made. Results show that (a) metastable quenched solid solution Cu-2wt percent Co alloys, or the same alloys aged to produce coherent Co-rich zones, do not differ greatly from elemental Cu in their behavior under 1 MeV electron irradiation. When the same alloys are aged to form longer incoherent precipitate prior to HVEM irradiation, suppression of the early small loop stage of damage occurs but voids are nucleated in both cases; (b) metastable modulated microstructures in quenched or low temperature aged Cu-4wt percent Ti alloys completely surpressed void nucleation up to fluences on the order of 50 dpa. The very fine scale microstructural changes that occurred during irradiation in the modulated Cu-4wt percent Ti alloys were not resolved in detail, but it appears that the basic difference between Cu-4wt percent Ti and Cu-2wt percent Co was a much larger point defect sink density in the former, resulting in suppression of void nucleation. Since only one irradiation temperature was investigated, namely approximately 300^{0}C, these conclusions cannot be taken as a general statement concerning the merits of modulated structures with respect to radiation damage, but the results are encouraging. Certainly microstructural coarsening is to be expected during irradiation if the temperature is much above 350^{0}C, and the results may be quite different. (auth)

6043 (HEDL-SA-1012) FUNDAMENTALS OF DISPLACEMENT PRODUCTION IN IRRADIATED METALS. Doran, D. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-2170. 38p. (CONF-750952-3). Dep. NTIS $5.00.

From seminar on radiation-produced defects and defect clusters and their effects in metals; Ames, Iowa, USA (28 Sep 1975).

Radioinduced displacement damage in metals is described. Discussions are included on the displacement event itself, calculation of displacement rates in general, the manner in which different types of radiation interact with metals to produce displacements, the similarities and differences in the types of damage produced, the current status of computer simulations of displacement cascades, experimental evidence regarding cascades, and aspects of correlating damage produced by different types of radiation. (auth)

6044 DISORDERING OF LITHIUM FILMS ADSORBED ON THE (011) FACE OF TUNGSTEN CRYSTALS IRRADIATED BY SLOW ELECTRONS. Naumovets, A. G.; Fedorus, A. G. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz.; 68: No. 3, 1183-1188 (Mar 1975). (In Russian)

It is found that submonolayer lithium films adsorbed on the (011) face of a tungsten crystal are disordered on bombardment of the surface by slow electrons. The phenomenon is of a non-thermal nature and is characterized by a threshold energy of 54 eV. It is suggested that electron impact creates a vacancy in the K-shell of the lithium adatom, and the adatom–substrate system, in accordance with the Franck–Condon principle, undergoes a vertical transition to the potential curve of the excited state. On moving along this curve the adatom may acquire an energy sufficient for formation of a defect in the ordered two-dimensional lattice of the adatoms. (auth)

6045 COMMENT ON "FREE MIGRATION OF INTERSTITIALS IN TUNGSTEN". Seidman, D. N.; Wilson, K. L.; Nielson, C. H. (Cornell Univ., Ithaca, NY). Phys. Rev. Lett.; 35: No. 15, 1041-1042(13 Oct 1975).

Results are briefly summarized of an extensive series of recent field-ion microscope experiments on ion-irradiated (20- and 30-keV W^+) tungsten (with residual resistance ratios varying from 5 x 10^4 to 5), tungsten specifically doped with carbon, and tungsten–0.5-at. percent- and –3-at. percent-rhenium alloys. The experiments are all consistent with the long-range migration of a self-interstitial atom occurring at approximately 38^{0}K. This result is contrasted to the recent conclusions of Okuda and Mizubayashi. (auth)

6046 REPLY TO "COMMENT ON 'FREE MIGRATION OF INTERSTITIALS IN TUNGSTEN'". Okuda, S.; Mizubayashi, H. (Japan Atomic Energy Research Inst., Ibaraki). Phys. Rev. Lett.; 35: No. 15, 1043-1044(13 Oct 1975).

The argument by Seidman, Wilson, and Nielsen concerning our recent Letter is shown to be not decisive. We now propose that the defects associated with the 27^{0}K internal-friction peak in neutron-irradiated W may be di-interstitials. (auth)

6047 VACANCY TRAPPING AND DETRAPPING BY ^{111}In IMPLANTED IN Ni AS OBSERVED BY TIME-DIFFERENTIAL PERTURBED ANGULAR CORRELATIONS. Hohenemser, C.; Arends, A.; de Waard, H. (Univ. of Groningen, Netherlands). Phys. Rev., B; 11: No. 11, 4522-4524(1 Jun 1975).

With time-differential perturbed angular correlations on ^{111}In implanted in Ni, trapping and detrapping of vacancies was observed in the temperature interval 20 less than or equal to T less than or equal to 400^{0}C via isochronal annealing studies. (auth)

6048 RADIATION DAMAGE AND ION BEHAVIOR IN ION IMPLANTED VANADIUM AND NICKEL SINGLE CRYSTALS. Gettings, M.; Langguth, K. G.; Linker, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 241-255 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1973).

Distributions and annealing behavior of heavy ion induced radiation damage in single crystal nickel and vanadium are compared. Sharp annealing stages are reported for Ni while for V the production of a polycrystalline layer, ascribed to the action of precipitates, prevented the annealing of damage after high dose implantations. The use of $^4He^+$ ion channeling revealed disorder at depths much greater than the ions projected range, an observation that was supported by electron microscopy measurements. Implanted ion diffusion in vanadium was found to be dependent on the ion species used and the annealing behavior of precipitates. Results of quantitative measurements indicate that diffusion coefficients are low. (auth)

6049 ION IMPLANTATION IN SUPERCONDUCTING THIN FILMS. Meyer, O.; Mann, H.; Phrilingos, E. (Kernforschungszentrum, Karlsruhe, Ger.). pp 15-26 of Applications of Ion Beams to Metals. Picraux, S. T. (ed.). New York; Plenum Publishing Corp. (1973).

Selected ions were implanted at room temperature in thin films of the transition metal superconductors Ti, Zr, V, Nb, Ta, Mo, W, and Re, the A-15 compound Nb_3Sn, and the interstitial compounds NbC and NbN with NaCl structure. Both chemically active and inert ions were used in order to distinguish between radiation damage and other effects influencing the superconducting

transition temperature T/sub c/. Successively larger decreases in T/sub c/, due to radiation damage, were obtained for NbC, NbN, Mo, Ta, V, Nb and Nb_3Sn in that order. Chemically active ions were found to produce the same reduction in T/sub c/ as inert ions in Ta, V, Nb and Nb_3Sn, whereas in those materials in which radiation damage is less influential, namely NbC, NbN, Mo, W and Re, T/sub c/ enhancement was found to occur and was dose-dependent. (auth)

6050 NEUTRON IRRADIATION EFFECTS ON SUPERCONDUCTING MATERIALS IN THERMONUCLEAR FUSION REACTOR TECHNOLOGY. Tsubakihara, H. (Osaka Univ.); Okada, T.; Suita, T.; Horiuchi, H.; Matsumoto, K.; Tsurutani, S. pp 339-342 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A systematic study was carried out on Nb-Ti wires to investigate the effects of the metallurgical structures of the samples before irradiation on neutron irradiation induced J_c change. The two kinds of sample with different Ti concentrations are aged at 380°C for 0 to 10^4 min and irradiation was carried out up to a dosage of 1.3×10^{18} n/cm² at reactor temperature. The principal result observed here was that the J_c of the samples including precipitates have been decreased by the irradiation. It was concluded that the superconducting Nb-Ti wire with precipitation-enhanced J_c does not appear very resistant to neutron irradiation, so that careful consideration is stressed in the choice of superconducting wire in its application to fusion reactor magnets. (auth)

6051 DETAILS OF THE CHANGES IN CRYSTAL LATTICE PARAMETERS OF Fe-Al-C MARTENSITE IRRADIATED BY ELECTRONS. Kurdyumov, G. V.; Kritskaya, V. K.; Il'ina, V. A. (Inst. of Metal Ore and Physics of Metals, Moscow). Dokl. Akad. Nauk SSSR; 219: No. 5, 1099-1101(11 Dec 1974). (In Russian).

Four alloys having the following composition were prepared: Fe-3% Al-1% C; Fe-7% Al-1% C; Fe-3% Al-1.5% C; and Fe-7% Al-1.5% C. To obtain the martensitic structure all the alloys were quenched from 1200°C in water with subsequent cooling in liquid nitrogen. To remove the decarburized layer the samples were subjected to chemical etching. Samples after quenching were given a dose of ~10^{18} electrons per cm² with 5 Mev electrons from a linear accelerator. An x ray structural study showed that martensite containing 3 and 7% aluminum has a considerably higher degree of lattice tetragonality (c/a) in comparison with the tetragonality of unalloyed martensite of carbon steel with the same concentration of carbon in alpha-solid solution. Temperature stability intervals were determined for unirradiated and irradiated martensite alloyed with aluminum. It was established that in electron-irradiated, quenched, Fe-Al-C steel reversible changes of the lattice parameters occur at significantly higher temperatures than in the case of martensite of carbon steel. (SJR)

6052 IN SITU OBSERVATION OF THE GRAIN BOUNDARY/BUBBLE INTERACTION. Beere, W. (Berkeley Nuclear Labs., Eng.). Scr. Metall.; 9: No. 10, 999-1001(Oct 1975).

The interaction of a migrating grain boundary in copper with microscopic helium bubbles was observed using an electron microscope. The helium bubbles were introduced by irradiating the thin foil in an ion beam accelerator to a dose of 3 muamp seconds/mm² with helium ions at 8 kV. A subsequent anneal for two hours at 450°C in vacuum precipitated the helium bubbles. The thin foil was transferred to the heating stage of an electron microscope and plastically deformed to introduce a high dislocation density. A further anneal at 650°C in the microscope instigated the nucleation of a stress free grain. The new grain was encouraged to grow in the area under observation by condensing the electron beam onto a small area to produce localized heating. Temperatures were measured by a thermocouple welded to the heating stage. Microscopic observations revealed that the bubble increased noticeably in size on contact with the boundary. The advancing boundary unlocked part of the dislocation network causing dislocations in the old grain to move rapidly to a new equilibrium position. Small pores were dragged rapidly by the moving dislocations. The advancing boundary remained relatively straight despite passing through the pores. The angle subtended by the boundary on opposite sides of a pore was always greater than 170°. The bubbles were not dragged by the boundary. (auth)

Other Materials

Refer also to abstracts 5895, 5898, 5994, 6018, 6027, 6038, 6514, 6703, and 6867.

6053 (N-75-18547) THERMAL AND RADIATION DAMAGE TO SL/1 EREP FILMS. Perry, L. (Technicolor Graphic Services, Inc., Houston, Tex. (USA)). Sep 1973. 16p. (NASA-CR-141660; TN-73-8). NTIS $3.25.

Tests were conducted to determine the present sensitometric characteristics of the SL/1 EREP films stored in Skylab. These films underwent the high temperature environment at the beginning of the mission and have since been stored outside the film vault. As a result, the films will have received a radiation dose estimated at approximately 12 rads by the end of SL/3. (auth)

6054 (SLL-73-0287) SUMMARY OF PRELIMINARY STUDIES ON THE EFFECTS OF ^{60}Co GAMMA-RAY IRRADIATION OF FIBER OPTIC MATERIALS. Mattern, P. L. (Sandia Labs., Livermore, Calif. (USA)). Oct 1973. Contract AT(29-1)-789. 64p. Dep. NTIS $5.00.

Absorption induced by irradiation was measured from 185 to 1500 nm, using a computer-controlled Cary 17I spectrophotometer. Results indicate that most conventional fiber core glasses develop significant absorption bands in the near uv, visible, and near infrared regions at low doses (less than 10^4 rad). In polystyrene, the radiation-induced absorption losses are less severe. Two types of high purity synthetic fused silica were affected least of all by irradiation. In these vitreous silicas the only significant absorption bands observed were in the ultraviolet. (21 figures) (auth)

6055 (SRIA-37(Add.)) PLASMA-SPRAYED BORON FILMS AND COATINGS; A FEASIBILITY STUDY. Farley, E. P.; Engelke, J. L. (Stanford Research Inst., Menlo Park, Calif. (USA)). 19 Jan 1962. 19p. (UCRL-13021(Add.)). Dep. NTIS $4.50.

Declassified 20 Oct 1971.

Results of work directed to production of B spheres are reported. The stockpile boron supplied by LRL was processed through the Institute's plasma spheroidizer in suitable particle-size fractions. Physical properties were altered in all sizes, although complete spheroidization of individual particles appeared only at 200 mesh (74 mu) and below. The products from the spheroidizer were characterized with respect to their particle size, sphere content, packing density, and surface area. An average sphere content of 50 to 60 percent (particle-count technique) was obtained for size fractions below 200 mesh. By mixing portions of the various particle-size products from initial tests to represent the composition of the bulk sample, packing densities as high as 1.54 g/cm³ were achieved, but in the practical processing of the bulk sample, a final mixture with a packing density of 1.37 g/cm³ was obtained. This was a 26.9 percent increase over the as-received material which had a density of 1.08 g/cm³. This final mixture (400 g) was submitted to LRL. Surface area for the bulk material was reduced from 8.55 to 3.14 m²/g. The flowability of the stockpile material was greatly improved, and with the parameters developed under the present program, a 30 percent increase in deposition efficiency can be expected in plasma-sprayed boron coatings as compared with the values obtained in the initial portion of this program. (auth)

6056 (UCRL-Trans-10947) DELAY IN BOILING OF LIQUID SHEET GLASS WITH ELECTRON IRRADIATION. Dudek, H. J. Translated from Naturwissenschaften; 57: No. 9, 450(Sep 1970). 5p. Dep. NTIS $4.50.

When a well-collimated electron beam of 100 keV hits the surface of material, either formation of holes (eruption) or melting occurs. In sheet glass, holes can be drilled with this method, but if the glass moves during irradiation, the material boils and forms glass foam. Various transition states between hole formation and boiling can be obtained by varying pulse frequency, impulse duration, beam diameter, and speed of glass motion. (DLC)

6057 DEFECTS IN GaP IRRADIATED BY ELECTRONS. Brailovskii, E. Yu.; Konozenko, I. D.; Tartachnik, V. P. (Inst. of Nuclear Research, Kiev). Fiz. Tekh. Poluprov.; 9: No. 4, 769-771(Apr 1975). (In Russian)

The introduction and annealing of point radiation defects in GaP were investigated. The investigations were conducted on singles of GaP of n and p types grown by extraction from a melt and doped with Te or Zn with an initial current carrier concentration of 10^{16}-10^{18} cm^{-3} and a mobility of 70 to 110 $cm^2/V \cdot s$ for the electrons and 50 to 80 $cm^2/V \cdot s$ for the holes. High-temperature annealing is observed both in n and p types of GaP at temperatures above 400°C and differs in the various crystals in size and temperature range. This is possibly due to the association of point defects with impurities or with one another. Thus irradiation by electrons with an energy of 1 MeV causes several types of point radiation defects to be introduced into the crystals of GaP, leading to a compensation of the conductivity in both n- and p-type GaP. (JPRS)

6058 ACOUSTIC EMISSION FROM COMPOSITE-REINFORCED METALS. Henneke, E. G. II.; Herakovich, C. T.;

Jones, G. L.; Renieri, M. P. Exp. Mech.; 15: No. 1, 10-16 (Jan 1975).

Acoustic-emission (AE) count rates are presented for tensile loading of unidirectional B epoxy and for Al sheets reinforced with unidirectional B epoxy. It is shown that different prepreg materials have different characteristic AE patterns. Results from composite-reinforced metal specimens show that early failures are accompanied by a sharp increase in AE count rate at the knee of the bilinear stress-strain diagram. The count rates are a function of specimen fabrication and higher total counts do not necessarily correspond to early failures. The Al alloy 7075-T6 was used in the investigation. (Metals Abstr.)

6059 DEPENDENCE OF THE YIELD OF RADIATION DEFECTS AND THEIR ENERGY CAPACITY ON THE DENSITY OF ORIGINAL STATES. Vaisburd, D. I.; Sirota, N. N. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 104-109(1975). (In Russian).

Experimental relations were obtained for the yield and energy capacity of the defect formation on the density of the original states. It was indicated that at fixed proton energy the energy capacity of the defects decreases to the smallest value ϵ_0 = 500 eV/def. The energy yield was practically linear and was saturated at the specific energy capacity 2.5×10^{20} eV/cm^3. It was shown that these yields follow directly from the symmetry of the established integral transformation of the radial distribution of the excitation density in the track $\rho_E(r)$ into the radial distribution of the concentration of radiation defects $p_E(r)$. (tr-auth)

6060 ELECTRONIC CONTRIBUTION TO THE C-AXIS ELASTIC CONSTANTS OF HEXAGONAL CRYSTALS. Green, J. F.; Spain, I. L. Phys. Rev. Lett.; 11: No. 10, 3935-3943 (15 May 1975).

The effect of c-axis elastic strain on the first Brillouin zone for hexagonal crystals is determined. The electronic contribution to c-axis elastic moduli is estimated for graphite, a semimetal, and boron nitride, an insulator, using the parabolic and other band models. It is found that a large contribution to the elastic constants can arise from the effect of strain on the electronic energy, arising from a redistribution of electrons within the strained Brillouin zone, or from changes in the bulk electronic properties. It is shown that experimental c-axis moduli for graphite can be described empirically if both ion-ion and electron band energies are considered. (7 fig, 29 references) (auth)

6061 FOURTH-ORDER ELASTIC CONSTANTS AND THE TEMPERATURE DEPENDENCE OF SECOND-ORDER ELASTIC CONSTANTS IN CUBIC MATERIALS. Garber, J. A.; Granato, A. V. (Univ. of Illinois, Urbana). Phys. Rev. Lett.; 11: No. 10, 3998-4007(15 May 1975).

A theory analyzing the temperature dependence of second-order elastic constants on the basis of a quasiharmonic-anisotropic-continuum model is applied to LiBr, KCl, RbF, beta-brass, Cu, Ag, and Au. The number of fourth-order elastic constants is reduced from 11 to 2 by assuming that nearest-neighbor (nn) and next-nearest-neighbor (nnn) central-force interactions predominate in fourth order. The fourth-order elastic constants found from the experimental results show that nn interactions are dominant for the NaCl structure and that nnn interactions are dominant for the CsCl structure, as would be expected for a potential containing a term describing a rapidly varying central-core repulsion. Using recent measurements for Cu in the low-temperature T^4 regime where the anisotropic-continuum theory should be exact, a potential is derived which is in close agreement with one used extensively in point-defect calculations. (6 tables) (auth)

6062 LUMINESCENCE IN SOLID KRYPTON. Reynolds, C. L. Jr.; Couchman, P. R. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett.; 11: No. 10, 4061-4062(15 May 1975).

Measurements by Lewis and Teegarden of the x-ray-induced luminescence of solid Kr were reanalyzed on the basis of simple rate theory. For irradiation times greater than 20 s, agreement between theory and experiment is excellent. (auth)

6063 STUDY OF THE POTENTIAL DISTRIBUTION ON IRRADIATED SILICON p-n-p-n STRUCTURES. Koshunov, F. P.; Shupenev, V. A. (Inst. of Solid State Physics and Semiconductors, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 129-131(1975). (In Russian).

The potential distribution on a four-layer p-n-p-n structure was investigated using a W probe. The semiconductors were Si based with specific resistivity of 40 Ω cm. Potential distribution curves along the coating of the p-n-p-n structure were obtained at low injection levels before and after irradiation with 25 MeV electrons. It was established that the greatest potential change, both on the non-irradiated and the irradiated samples, occurred in the narrow range of the n base close to the central p-n transition. The calculated and experimental data were compared and satisfactory agreement was obtained. (tr-auth)

6064 STRENGTH OF CONCRETE SUBJECTED TO COMPRESSION-COMPRESSION-TENSION STRESS SYSTEMS. Mahmood, N. (Middlesex Polytechnic, Enfield, Eng.); Hannant, D. J. J. Test. Eval.; 3: No. 2, 107-112(Mar 1975).

An experimental investigation into the failure of a particular concrete subjected to stress fields varying between biaxial compression, compression-compression-tension, and uniaxial tension is described. The results are compared with published data for related stress systems, and the shape of the failure surface in the compression-tension quadrants of stress space is shown to be of the simple hexagonal pyramid type. (auth)

6065 USE OF QUANTITATIVE METALLOGRAPHY AND STEREOLOGY IN THE STUDY OF COMPOSITE MATERIALS. I. Critical Study of the Methods. Application to Quantitative Fracture Path Studies. Chermant, J. L.; Coster, M.; Deschanvres, A. (Univ., Caen, France). Metallography; 8: No. 4, 271-291 (Aug 1975). (In French).

To measure the parameters which characterize the morphology of materials, it is necessary to use quantitative metallography and stereology. It seemed natural to extend these methods to quantitative fractography. Firstly, it was shown that transmission and scanning electron microscopes are equivalent apparatus for the observation of fracture path. Then a critical investigation of stereological methods proved that corrective methods established for spherical particles can be used for non-spherical particles and, with modifications, for fracture path investigation. The critical study of the surface ratios of fracture occupied by each phase was investigated as a function of the conditions of observation for various microstructural parameters. Materials studied included WC-Co, bronze, and chrome. (14 figs, 5 tables) (auth)

6066 SUPERCONDUCTING PROPERTIES OF V_3Ga IN THE V-Ga/Cu-Ga COMPOSITE SYSTEM. Howe, D. G.; Weinman, L. S. (Naval Research Lab., Washington, DC). pp 326-328 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A study of V_3Ga wires grown by solid-state reaction is presented. Alloy compositional ranges covered in this investigation were 0 to 9.0 atomic % Ga in the V filament and 15.4 to 17.5 atomic % Ga in the Cu matrix. Growth rates for V_3Ga were largely influenced by alloy composition with more rapid growth occurring in the composite wires with higher Ga composition. J_c measurements in transverse magnetic fields up to 175 kG were made and were dependent on the formation temperature and V_3Ga layer thickness. The best data observed was for a wire reacted at 550°C where a J_c of 10^6 A/cm^2 at 100 kG was obtained. (auth)

6067 LOW-TEMPERATURE THERMAL AND MECHANICAL PROPERTIES OF POLYSTYRENE AND POLYETHYLENE FOAMS. Foley, R. J. (Univ. of California, Livermore); Jelinek, F. J. pp 439-442 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

An experimental study was conducted to determine the thermal contraction and thermal conductivity of polystyrene-beaded foams of densities 0.05 and 0.1 g/cm^3 and open-cell polyethylene foam of density 0.22 g/cm^3. Values are given in the range from 4 to 300°K. Compressive and tensile strength properties were evaluated for the polystyrene foams at 300, 77, and 20°K. Thermal contraction behavior of the polystyrene foam materials appears to be nearly independent of density. However, thermal conductivity of the material was affected by density changes when evacuated to 1.3×10^{-4} Pa to reduce the effect of gas conduction. The compressive and tensile strengths also appear to be affected by density. Thermal contraction and conductivity results indicate the anisotropic effects in the contraction behavior of the polyethylene material. (auth)

6068 ALUMINUM MATRIX MULTI-CORE Nb/Ti COMPOSITE SUPERCONDUCTING WIRE. Nanba, H.; Hinata, M. (Sumitomo Electric Industries Ltd., Osaka). pp 490-493 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Seven-core Nb/Ti composite superconducting wires whose matrix materials are industrial purity Al, 2017 alloy and 5052 alloy have been produced by means of the hydrostatic extrusion

technique. These samples have been studied from the viewpoint of stabilizing properties. (auth)

6069 THREE-COMPONENT COMPOSITE SUPERCONDUCTOR. Meguro, S.; Furuto, Y.; Suzuki, T.; Ikeda, M.; Tanaka, Y.; Inoue, I. (Furukawa Electric Co. Ltd., Tokyo). pp 504-507 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Several kinds of three-component composite superconductors were fabricated by means of the hot extrusion process. Critical current, ac loss, and other characteristics of the composites were measured. Results of measurements are given along with discussions of manufacturing technology and ac characteristics of the composites. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

6070 (CONF-741026-, pp 10-37) RADIOLOGICAL PROTECTION AND TRANSURANIC WASTES FROM THE NUCLEAR FUEL CYCLE. Morley, F.; Kelly, G. N. (National Radiological Protection Board, Harwell, Eng.). 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The significant higher actinides in the nuclear fuel cycle are identified and current knowledge of their radiotoxicity is reviewed with particular emphasis on plutonium. Experience of plutonium in the environment is briefly summarized. The origins of fuel cycle wastes contaminated by actinides are described and available data examined to estimate the amounts of radioactivity involved now and in the future. The radiological importance of individual isotopes of the various actinide elements in wastes is compared and attention drawn to changes with time. Some possible alternative waste management policies are reviewed against the requirements of radiological safety. (auth)

Accountability and Safeguards

Refer also to abstracts 4956, 4957, 4971, and 5604.

6071 SOME THOUGHTS ON CONSTANT AND VARIABLE COMPONENTS OF SYSTEMATIC ERROR. Suda, S. C. (Brookhaven National Lab., Upton, NY). Nucl. Mater. Manage.; 4: No. 1, 41-43(Spr 1975).

Treatments of systematic error in the past are reviewed. Some characteristics of systematic error are suggested. There are at least four types of measurements for which separate procedures can be formulated for estimating the variable and constant components of systematic error; one of them is counting measurements on nuclear materials. (DLC)

6072 SOME THOUGHTS ON "SOME THOUGHTS ON RANDOM ERRORS, SYSTEMATIC ERRORS, AND BIASES" BY JOHN L. JAECH. Moore, R. H. (U.S. Nuclear Regulartory Commission, Bethesda, MD). Nucl. Mater. Manage.; 4: No. 1, 44-46(Spr 1975).

These thoughts pertain to the topic of errors in nuclear materials control. It is concluded that, as Jaech states, there is no 'right' way to treat the combined effect of systematic errors or biases, and that it is better to keep the components separate. (DLC)

6073 DEVELOPMENT OF A COMPLETE SYSTEM DETERMINING ROUTINE INSPECTION EFFORTS AND TIMING FOR FABRICATION PLANTS. Haginoya, T. (Mitsubishi Metal Corp., Tokyo). Nucl. Mater. Manage.; 4: No. 1, 39-40(Spr 1975).

Routine inspection efforts should be determined taking into account not only the analysis of MUF, but also various other factors in the fuel cycle. A complete system for determining actual routine inspection efforts for any facility (which processes UF_6 with enrichment less than 5 percent and produces UO_2 powder or fuel assemblies) was developed and is outlined. Application is made to facilities in Japan. (DLC)

Disposal and Storage

Refer also to abstracts 5072, 5074, 5075, 5081, 5088, 5089, 5093, 5098, and 5594.

6074 (BNWL-SA--5507) ALTERNATIVES FOR RADIOACTIVE WASTE MANAGEMENT. Bartlett, J. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)-1830). 21p. (CONF-751044--1). Dep. NTIS $4.25.

From ANS topical meeting on nuclear safety; Tucson, Arizona, USA (5 Oct 1975).

The safety aspects of waste management alternatives are emphasized. The options for waste management, their safety characteristics, and the methods that might be used to evaluate the options and their safety are outlined. (LK)

6075 (CONF-741026-, pp 111-123) STORAGE OF TRANSURANIC CONTAMINATED SOLID WASTES AT THE IDAHO NATIONAL ENGINEERING LABORATORY. Wehmann, G. (Atomic Energy Commission, Idaho Falls, ID); Hickman, W. W. 1974.

From seminar on the management of plutonium-contaminated solid wastes; Marcoule, France (14 Oct 1974).

In proceedings of the seminar on the management of plutonium-contaminated solid wastes.

The storage method for low-level transuranic wastes employed at the Idaho National Engineering Laboratory is discussed in detail. The techniques used for wastes containing greater than (10) nanocuries of transuranic material per gram of waste as well as the technique for lesser concentrations of transuranic wastes are described. The safety, efficiency and adequacy of these storage methods are presented. (auth)

6076 (HW-64375) RADIOACTIVE CONTAMINATION IN LIQUID WASTES DISCHARGED TO GROUND AT THE SEPARATIONS FACILITIES THROUGH DECEMBER 1959. McConiga, M. W. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 13 May 1960. 28p. Dep. NTIS $5.00.

Declassified 17 Dec 1973.

Open disposal sites at the separation areas have received approximately 1.48×10^{11} liters since startup. Approximately 2,509 Ci of fission products and 446 g of plutonium were contained in this waste. Exclusive of large volume open waste disposal sites, the estimated volume of waste discharged to ground since startup was 1.54×10^{10} liters. Included in this is over 2,515,200 Ci of fission products and 43.10 k of plutonium. (auth)

6077 SOLIDIFIED WASTE IN-SITU MELTING DISPOSAL. Angelo, J. A. Jr. (Florida Inst. of Tech., Melbourne); Woodbridge, D. D.; Post, R. G. Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 35-36(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Handling Equipment and Procedures

Refer also to abstract 5106.

6078 (BNWL-SA-5547) CRITICALITY SAFETY TRAINING PROGRAM AT BATTELLE-NORTHWEST. Friar, D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 3p. (CONF-751101-50). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

The criticality safety training program used at Battelle-Northwest is described. In this program criticality safety specialists, dealing with small groups of fissile materials handlers, explain the principles of criticality safety and show how these principles are actually applied in the laboratory. (LCL)

6079 (DP-MS-75-89) SUBCRITICAL MASS LIMITS FOR THE T-INSERT. Clark, H. K. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 8p. (CONF-751101-43). Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Safe limits are derived for Class III shipments of ^{235}U, ^{239}Pu, and ^{233}U in the T-insert within the ANL T-2 cask. The cask has a 6.063-in.-dia cavity enclosed by lead 8 in. thick and clad with steel. The insert is 5-in. Schedule 40 stainless steel. No control is exercised over the configuration of the fissile material. The most restrictive of the conditions that must be satisfied for a Class III shipment is the requirement that the cask be subcritical when flooded internally and externally with water. Mass limits for the cask were calculated by ANISN with S_4 quadrature, Hansen-Roach cross sections were used, supplemented by some with the same group structure from other sources. To establish the bias in the method, calculations of k/sub eff/ were compared with appropriate critical experiments with aqueous solutions of ^{233}U, ^{235}U, and Pu and with HFIR experiments in which the core was reflected by steel, lead, and water. (TFD)

Transportation

6080 (SAND-75-0446) FINAL REPORT ON SPECIAL TESTS ON PLUTONIUM OXIDE SHIPPING CONTAINERS TO FAA FLIGHT RECORDER SURVIVABILITY STANDARDS. McWhirter, M.; Brooks, R. O.; Stomp, J. M.; Dillingham, L. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1975. Contract AT(29-1)-789. 172p. (NUREG-SAND-75-0446). Dep. NTIS $7.75.

The purpose of the test series was to evaluate the leak tightness of typical plutonium oxide shipping containers when subjected to the same test requirements to which the FAA subjects their flight recorders. The containers chosen for evaluation were the LLD-1 package made by Dow and revised by DuPont, the Rocky Flats Model 1518 (DOT-SPEC 6M) container, and the Nuclear Containers, Inc., Modified FL-10 Container modified to 55-gallon drum size. The tests included impact, penetration, static crush, fire resistance, and water resistance. (TFD)

PARTICLE ACCELERATORS

Design, Development, and Operation

6081 (AECL-4913) STUDY OF A SUPERCONDUCTING HEAVY ION CYCLOTRON AS A POST ACCELERATOR FOR THE CRNL MP TANDEM. Fraser, J. S.; Tunnicliffe, P. R. (Eds.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1975. 214p. Dep. NTIS (US Sales Only) $8.75. AECL $3.00.

Results are reported of a study of the accelerators and research areas capable of producing beams of all heavy ions up to uranium with energies of at least 10 MeV per nucleon at an energy resolution of ~0.01%. It is concluded that the existing MP Tandem injecting into a compact superconducting cyclotron is a very economical solution that meets most of the requirements. The proposed cyclotron uses air cored superconducting coils to generate an internal magnetic field of up to 5T. The azimuthal field variation (flutter) is created by four pairs of saturated iron poles above and below the midplane and occupying less than half the azimuth of each sector. Rf dees fill the other half of each of the four sectors. The NbTi superconducting coils are mounted in cryostats immersed in liquid helium at 4.2 K. (auth)

6082 (ANL/SSS-74-1) FEASIBILITY STUDIES OF AN ACCELERATOR FOR THE INTENSE PULSED NEUTRON SOURCE (IPNS). Khoe, T. K.; Kimura, M. (Argonne National Lab., Ill. (USA)). Nov 1974. Contract W-31-109-Eng-38. 29p. Dep. NTIS $4.50.

A proton linac plus synchrotron system was studied for the proposed Intense Pulsed Neutron Source (IPNS) at Argonne. An Alvarez H^- linac of 70 MeV and a high intensity fast cycling proton synchrotron to accelerate protons to 800 MeV will be the best choice to give a flux of 10^{16} thermal neutron/sec cm^2 at the surface of moderator with a spallation neutron target of W or ^{238}U. (auth)

6083 (CONF-750947-) EXPERIMENTAL METHODS FOR CHARGED-PARTICLE IRRADIATIONS. Proceedings of a Symposium Held at Gatlinburg, Tennessee on September 30, 1975. Kramer, D. (ed.). (Atomics International Div., Canoga Park, Calif. (USA)). Sep 1975. 100p. Dep. NTIS $5.45.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

Six papers are presented resulting from an effort to define recommended procedures for conducting irradiation experiments for neutron radiation damage simulation. The topics include: (1) operation of Van de Graaff heavy ion facilities at Oak Ridge and the University of Pittsburgh; (2) design of a ring lens for producing uniform density ion beams; (3) design of a sample holder for determining temperature dependence of heavy ion-induced swelling; (4) a technique for determining sample temperatures in high voltage electron microscope studies of simulated neutron damage; and (5) a high temperature, high vacuum facility for Van de Graaff heavy ion simulation studies. A separate abstract was prepared for each paper for Nuclear Science Abstracts (NSA) and for Energy Research Abstracts (ERA). (PMA)

For abstracts of individual papers see: 5556, 6084, 6085, 6093, 6094, and 6115.

6084 (CONF-750947-, pp 1-14) HIGH ENERGY ION BOMBARDMENT SIMULATION FACILITY AT THE UNIVERSITY OF PITTSBURGH. McGruer, J. N. (Univ. of Pittsburgh, PA); Choyke, W. J.; Doyle, N. J.; Spitznagel, J. A. Sep 1975.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

In experimental methods for charged-particle irradiations. (Atomics International Div., Canoga Park, Calif. (USA)).

The High Energy Ion Bombardment Simulation (HEIBS) Facility located at the University of Pittsburgh is now operational. The E-22 tandem accelerator of the Nuclear Physics Laboratory, fitted with a UNIS source, provides the heavy high energy ions. An auxiliary Van de Graaff accelerator is used for the simultaneous production of He ions. Special features of the simulation laboratory are reported. (auth)

6085 (CONF-950947-, pp 15-37) OAK RIDGE CN VAN DE GRAAFF FACILITY FOR HEAVY ION RADIATION DAMAGE STUDIES. Lewis, M. B.; McGowan, F. K.; Johnson, C. H.; Saltmarsh, M. J. (Oak Ridge National Lab., TN). Sep 1975.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

In Experimental methods for charged-particle irradiations. (Atomics International Div., Canoga Park, Calif. (USA)).

The Oak Ridge CN Van de Graaff accelerator was set up to deliver heavy beams useful for radiation damage studies. Beams of well defined energy, isotope, and charge state can be brought on target with an intensity in excess of 1 particle microamp, uniformly spread over a square centimeter area. Methods were devised to measure both the on-line intensity and uniformity of the heavy ion beam. (auth)

6086 (JINR-R9-7339, pp 22-32) MAIN PARAMETERS AND RESULTS OF STUDIES ON THE ACCELERATOR SYSTEMS. Vasilenko, A. T.; Glazov, A. A.; Denisov, Yu. N.; Dmitrievskii, V. P.; Zaplatin, N. L.; Kol'ga, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Considerations used in selecting the parameters for the U-120M accelerator are presented. Specifications for the magnetic field, the high-frequency systems, the vacuum systems, the ion source and the beam exit system are examined. Numerous adjustments in the accelerator are planned for 1974. (INIS)

6087 (JINR-R9-7339, pp 33-47) DESIGN OF THE MAIN CYCLOTRON UNITS. Vasilenko, A. T.; Denisova, L. G.; Korneev, B. E.; Sidorova, V. I.; Soroko, V. M. 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Specific features of the construction of a resonator, dee, accelerator chamber, and beam exit system of the isochronous cyclotron U-120-M are considered. (tr-auth)

6088 (JINR-R9-7339, pp 147-162) SPECIFIC FEATURES OF THE PLANNED RECONSTRUCTION OF THE KRAKOV U-120 CYCLOTRON INTO AN ISOCHRONOUS ONE. Skhvabe, E. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Possibilities of improving the operating characteristics of the Krakov U-120M cyclotron by stabilization of the voltage and phases at the dee in order to increase the monoenergetics of the beam are discussed. The possibilities of increasing the proton and deuteron energy range, of simultaneous operation on two beams, and of accelerating heavy ions are considered. (INIS)

6089 (JINR-R9-7339, pp 181-199) USE OF CYCLOTRONS FOR STUDIES ON NUCLEAR REACTIONS AND IN APPLIED RESEARCHES. Venikov, N. I.; Ogloblin, A. A. (Inst. of Atomic Energy, Moscow). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The basic parameters of the cyclotron beam are examined, i.e., the intensity, maximum ion energy, energy resolution, energy stability, and the effect of these on the nature of the experiment. These characteristics are compared with the parameters of the tandem beam. The chief types of experiments which can be done on a small cyclotron are considered, e.g., correlation experiments, scattering of complex particles, neutron spectrometry, measurements of nuclear constants for thermonuclear reactors, study of radiation damage, and fast-neutron radiation therapy. (INIS)

6090 (JINR-R9-7339, pp 264-267) ADVANTAGES OF MODIFYING THE U-120 CYCLOTRON INTO THE ISOCHRONOUS CYCLOTRON U-120M WITH REGARD TO PREPARATION OF RADIOACTIVE SAMPLES FOR MEDICAL PURPOSES. Svoboda, K.; Kopetski, P.; Marek, I. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Characteristics of the U-120 cyclotron and its modification, the U-120M, are compared. The possibilities of using the U-120M cyclotron (accelerator for particles with a wide energy range, improved focusing and beam emittance) for producing radioisotopes are discussed. (INIS)

6091 (JINR-R9-7339, pp 268-285) RADIATION SITUATION IN THE CYCLOTRON BUILDING. Beskrovnaya, L. G.; Komochkov, M. M.; Teterev, Yu. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Results are reported of evaluating the neutron- and gamma-radiation fields of induced radioactivity and radioactivity of water and air, made for the purpose of determining the effectiveness of shielding of the U-120 cyclotron after its modernization to the U-120M isochronous cyclotron. Calculations were made for a 100 μA beam of 41-MeV protons, a 100 μA beam of 20.8-MeV deuterons, a 50 μA beam of 53-MeV ^{3}He ions, and a 100 μA beam of 41.6-MeV ^{4}He ions. (INIS)

6092 (LAL-1281) D.C.I.: THE NEW ELECTRON-POSITRON STORAGE RING AT ORSAY. Buon, J. (Ecole Normale Superieure, 91-Orsay (France). Lab. de l'Accelerateur Lineaire). Sep 1975. 25p. Dep. NTIS (US Sales Only) $4.50.

DCI (Collision Device in the Igloo target room at Orsay) is an unconventional double ring, intended to operate in a sophisticated way (space charge compensation) in order to overcome the space charge limitations and to achieve much higher luminosity than other rings at the same energy. The luminosity limitations are described, and the principle of the space charge compensation and the main characteristics of DCI are given. The high energy physics program on DCI, and the detection apparatus are presented. (auth)

Auxiliaries and Components

Refer also to abstract 6083.

6093 (CONF-750947-, pp 41-50) TECHNIQUES FOR RAPID SCREENING OF THE SWELLING CHARACTERISTICS OF ION-IRRADIATED METALS. Taylor, A. (Argonne National Lab., IL); Stubbins, J.; Moteff, J. Sep 1975.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

In experimental methods for charged-particle irradiations. (Atomics International Div., Canoga Park, Calif. (USA)).

Heavy-ion bombardment of prospective nuclear reactor metals has yielded large quantities of data concerning void-swelling susceptibility. To mitigate several of the experimental complications with charged-particle irradiation, a temperature-gradient target holder was developed for quick, efficient screening of the temperature dependence of void swelling. This specimen holder was designed so that three specimen foils could be held in the same temperature gradient during irradiation. Postirradiation studies of the surface topography (step-height measurements) and the void microstructure of one specimen yields information on the void swelling as a function of temperature. (auth)

6094 (CONF-750947-, pp 82-97) HIGH TEMPERATURE, HIGH VACUUM FACILITY FOR HEAVY ION SIMULATION STUDIES. Lott, R. G.; Smith, H. V. Jr. (Univ. of Wisconsin, Madison). Sep 1975.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

In experimental methods for charged-particle irradiations. (Atomics International Div., Canoga Park, Calif. (USA)).

A high vacuum irradiation facility for heavy ion simulation studies with a tandem accelerator is described. Specimen irradiations are performed at vacuums of less than 10^{-8} Torr. The samples are heated to temperatures as high as 1100°C by a thermal radiation heater. Partial pressure analysis reveals that H_2, H_2O and CO are the main constituents (approximately 97 percent) of the vacuum. Smaller amounts of CO_2, CH_4 and C_2H_4 (approximately 3 percent total) are also present. Beam charge state distribution and beam purity are measured by Rutherford scattering from a gold foil. Beam current densities and profiles are also measured. (auth)

6095 (JINR-R9-7339, pp 48-61) FORMATION OF THE MAGNETIC FIELD OF THE U-120M ISOCHRONOUS CYCLOTRON. Alenitskii, Yu. G.; Zaplatin, N. L.; Kropin, A. A.; Morozov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

A description is given of magnetic field measurements for a system of spiral and sector shims for the isochronous cyclotron U-120M. Using the current elements with selected parameters, it is possible to obtain an average field with a deviation from isochronicity of the order of 5×10^{-4} for the given particle energy range of Ep = 13 to 40 MeV, E_d = 8 to 20 MeV. The chief parameters of the magnet system of the cyclotron are given. (INIS)

6096 (JINR-R9-7339, pp 62-74) POWER SUPPLIES FOR THE EXCITATION AND CORRECTION COILS OF THE U-120M CYCLOTRON ELECTROMAGNET. Bogomolova, L. K.; Denisov, Yu. N.; Kalinichenko, V. V.; Perezhogin, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Special features of the power supply of the activation and correcting windings of the electromagnet of the U-120M cyclotron are described. The power supply system is based on stabilized sources of direct current. The measuring element is a magnetic comparator on two toroidal tape cores made of Permaloy. Properties of the magnetic comparator are presented. (INIS)

6097 (JINR-R9-7339, pp 82-92) COMPUTER PROGRAM PACKAGE FOR THE ANALYSIS OF THE U-120M ISOCHRONOUS CYCLOTRON MAGNETIC FIELD. Alenitskii, Yu. G.; Vorozhtsov, S. B.; Zaplatin, N. L.; Morozov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The functional purpose of a system of programs for analyzing the magnetic field of the U-120M isochronous cyclotron is described. The system consists of three basic programs: (1) DATMES, for analyzing the accuracy of magnetic field measurements recorded on punched tape; (2) SMOOTHMR for smoothing the results of the harmonic analysis in order to obtain a good first derivative of the experimental characteristics of the magnetic field; and (3) MONSTR for forming the necessary magnetic field. Program operating regimes are described. All programs are written in FORTRAN for the SDS-1604A machine. (INIS)

6098 (JINR-R9-7339, pp 116-128) EXPERIMENTAL STUDIES IN THE VOLTAGE STABILIZATION ON THE MODEL OF THE CYCLOTRON RF SYSTEM. Glazov, A. A.; Kochkin, V. A.; Semenov, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The results of experimental studies on stabilization of the amplitude of the high-frequency tension on a model of the high-frequency tension on a model of the high-frequency system of the U-120M cyclotron are presented. The study was made with and without automatic regulation of the amplitude. The instability of the amplitude due to a change in the potential of the feed sources and in the amplitude of the generator was studied. (INIS)

6099 (JINR-R9-7339, pp 129-132) CONTROL OF THE CYCLOTRON RF SYSTEM. Glazov, A. A.; Kochkin, V. A.; Semenov, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The special features of a control system for the high-frequency unit of the U-120M isochronous cyclotron are described. Basically, the system was developed assuming a dependence of all cyclotron systems on the energy necessary for accelerating and extracting the beam. The special features of the circuit reconstruction are considered. (INIS)

6100 (JINR-R9-7339, pp 133-146) CONTROL SYSTEM OF THE U-120M ISOCHRONOUS CYCLOTRON. Anosov, V. N.; Denisov, Yu. N.; Lyubenko, A. N.; Chigak, M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

A control system for the isochronous cyclotron U-120M is described for the phase of the beam in the dee gap. A computer processes the signals from the data unit and calculates the correction current for the concentric accelerator windings. The operating regimes of the system are described, and program reliability is discussed. (INIS)

6101 (JINR-R9-7339, pp 175-180) NUCLEAR MAGNETIC RESONANCE STABILIZATION OF A MAGNETIC FIELD. Marzhik, M.; Drasky, V.; Yaksh, M.; Goly, M.; Irovets, M. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The principle of action and the special features of a nuclear-magnetic resonance stabilizer for a magnetic field are described. The basic elements of the equipment are a controlled source of the stabilized field, electromagnet, magnetic induction-to-frequency transformer, a reference frequency generator, and transformer of the deviation of induction into the voltage. A nuclear magnetic resonance method is used for measurements on the magnetic field, which permits transforming the induction of the magnetic field into frequency with high precision. Local modulation of the magnetic field is used for obtaining a nuclear magnetic resonance signal. The basic properties of the equipment are presented. (INIS)

6102 DIGITAL MEASUREMENT OF PULSED HIGH-FREQUENCY POWER. Alferov, V. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 483-484(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 128-129(1975).

A method is described for measuring transmitted power of megawatt order at a frequency of approximately 3 GHz on the basis of converting the pulsed signal (having a duration of 3 to 10 μsec) from the tube detector head operating according to a square law into a sequence of pulses recorded by a three-digit decimal counter. The linearity of the instrument is at worst 2% in the 18 db range. (auth)

6103 PULSED SUPERCONDUCTING MAGNETS FOR HIGH-ENERGY PHYSICS. Heinz, W. (Univ., Karlsruhe, Ger.). pp 517-522 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

In 1970, research of pulsed superconducting magnets was started. A series of smaller magnets was developed and successfully tested, leading to a superconducting magnet which fulfills most of the requirements for a high energy accelerator: operating field B = 4.5 T, length 1.4 m, cycle time t = 10 s, $\Delta B/B = 3 \times 10^{-3}$. Design philosophy, construction details, and performance are reported, and problems and further developments are discussed. (auth)

6104 LOSSES IN VARIABLE FIELDS: NUCLEAR USE OF PULSED SUPERCONDUCTING MAGNETS. Bronca, G.; Fevrier, A.; Genevey, P.; Perot, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 523-530 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

After a review of the theory of losses in type II superconductors and of recent work on this topic, the characteristics of what should be an ideal conductor for a pulsed magnet are given. The requirements of pulsed magnets for high energy physics are reviewed, and total losses for a 1000 GeV synchrotron estimated. Finally, recent results of prototypes are reported, along with projects of superconducting synchrotron accelerators through the world. (auth)

6105 DESIGN OF SUPERCONDUCTING MAGNETS FOR PROTON SYNCHROTRONS. Alexeev, V. P.; Galstian, E. A.; Greben, L. I.; Mironov, E. S.; Vasiliev, A. A. (Radiotechnical Inst., Moscow). pp 531-533 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A superconducting magnet design for high energy accelerators is discussed. Test results and the design scheme of SPD-2, a superconducting dipole with a 4T field, are presented. The field uniformity within 50% of aperture is better than 4×10^{-3}. A description of another dipole, SPD-3, with a better field accuracy is given. This dipole is under fabrication now. Also, some general aspects of magnet and cryogenic systems are discussed. (auth)

6106 STATUS REPORT ON THE KARLSRUHE PROTOTYPE SUPERCONDUCTING PROTON LINEAR ACCELERATOR. Citron, A. (Univ., Karlsruhe, Ger.). pp 534-538 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A short introduction about linear accelerators in general and about the advantages of using superconducting resonators is given. Some basic effects on r.f. superconductivity are reviewed, and the status of technology of surface preparations is reported. The status of the Karlsruhe accelerator is then given. In the low energy part, some difficulties caused by mechanical instabilities were overcome, and protons were accelerated in this part. Model studies for the rest of the accelerator were begun and look promising. (auth)

6107 LONG-TERM EXPERIENCE WITH THE FIRST CRYOSTAT OF THE SUPERCONDUCTING LINEAR ACCELERATOR DURING OPERATION ON A 300 W–1.8 K REFRIGERATOR. Herz, W.; Lehmann, W.; Spath, F. (Kernforschungszentrum, Karlsruhe, Ger.). pp 542-545 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

In a prototype of a superconducting rf linear accelerator, protons were accelerated with field strengths of 1.2 MV/m. The cooling circuit, designed for this purpose with the first He II cryostat at a 300 W–1.8 K refrigerator plant, has operated for 2500 hours to date. The operation data obtained for the cryostat in cryogenics- and vacuum-engineering (i.e. insulation losses 20 W, temperature stability in the He II bath < ±10 mK, level stability in the He II bath < ±1 mm, insulation vacuum $<10^{-6}$ torr, beam vaccum $<10^{-9}$ torr) conform with specifications and allow reliable use of the acceleration section. A short description of the cryostat is given, and the method of cooling, the instrumentation, and the cryostat long-term experience gathered with this cooling circuit are reported. The planned extension of the cryostat system is mentioned. (auth)

6108 PROGRESS REPORT ON A SUPERCRITICALLY COOLED SUPERCONDUCTING MUON-CHANNEL. Vecsey, G.; Horvath, I.; Zellweger, J. (Swiss Inst. for Nuclear Research, Villigen). pp 550-552 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.) Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The mechanical and electrical design of a 2 MJ solenoid are described, and the cryogenic and control aspects of supercritical cooling are analyzed. Results on a test system and its present state are reported. (auth)

Ion Sources and Injection and Extraction Systems

6109 (CONF-751048--1) PRODUCTION OF POSITIVE ION BEAMS FROM SOLIDS. Hudson, E. D.; Mallory, M. L.; Lord, R. S. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.50.

From international conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

A technique for making metal ions for cyclotrons is described. Metal and non-metal ions from solids are produced in a Penning ion source by a process that involves ions that are unable to cross the first acceleration gap between the ion source and dee and are accelerated back into the ion source where they sputter charge material into the arc. This material is ionized and extracted from the ion source and accelerated. This technique was used for a large variety of ions, both metal and non-metal, including aluminum from the metal and boron from boron nitride charge materials. The efficiency for making iron ions with different ion support gases was calculated, and these results were experimentally checked. A dual ion source is being designed for a dc Penning ion source test stand which makes an excellent source for producing ions from solids for dc extracted Penning ion sources. (auth)

6110 (CONF-751048--2) PENNING MULTIPLY CHARGED HEAVY ION SOURCE TEST FACILITY. Mallory, M. L.; Crandall, D. H. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. 4p. Dep. NTIS $4.50.

From international conference on heavy ion sources; Gatlinburg, Tennessee, USA (27 Oct 1975).

An ion source test facility was constructed for making fundamental measurements of the properties of Penning ion sources.

The extracted ion energies from the source can be up to 36 x q (keV), where q is the ion charge. Both negative and multiply charged positive ions were extracted from the source. The facility has high current capabilities for acceleration and for the arc power supply. These low-energy, multiply charged ions are currently being used for measurements of charge exchange cross sections, x-ray production, and electron impact excitation and ionization. (auth)

6111 (JINR-R9-7339, pp 93-101) SYSTEM FOR THE EXCITATION OF COHERENT RADIAL OSCILLATIONS AT THE EXTRACTION REGION. Dmitrievskii, V. P.; Kol'ga, V. V.; Polumordvinova, N. L; Treibal, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Special features of the system for activation of coherent radial beam oscillations in the area of particle exit from the U-120M isochronous cyclotron are described. In these systems, oscillation activation is brought about by the action of a basic activating field. For suppressing the parametric action of the main activating field, a second compensating field was introduced on the azimuth, separated from the first by 100°. The angular length of each field was selected to be 20°. The center of the electrode of the activating field was placed approximately 20° from the beginning of the deflector. Results of calculation and analysis made on the BESM-6 electronic computer of the process of beam oscillation buildup are presented. (INIS)

6112 (JINR-R9-7339, pp 102-115) CALCULATION OF THE BEAM ELECTROSTATIC EXTRACTION SYSTEM FOR THE CYCLOTRON. Dmitrievskii, V. P.; Kol'ga, V. V.; Polumordvinova, N. L; Treibal, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The special features and a diagram of a system for beam extraction in the U-120M isochronous cyclotron are described. The extraction system consists of three independent sections. The size of each section was selected from construction requirements with consideration of the space for the ion source and probe tubes. The first section, having a homogeneous electrostatic field and flat electrodes, deflects the beam and achieves an unstable region. The second and third sections form focusing forces relative to the center of the beam emittance, ensuring radial stability of the beam trajectory relative to the central point. A system of differential equations describing the movement of the charged particles in magnetic and electrostatic fields is derived, and results of a numerical computer calculation are presented. (INIS)

6113 (JINR-R9-7339, pp 163-169) POLARIZED ION SOURCE FOR THE U-120M CYCLOTRON. Bejhovets, V.; Marest, I. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

The results of development of a source of polarized ions for the U-120M cyclotron are presented, and the special features of the source, consisting of two basic parts, i.e., the source itself and the injection track are described. The injection system is based on the principle of dual recharging, i.e., neutralization of the ion beam outside the magnetic field of the cyclotron and the ionization of the beam as it passes through the carbon foil in the cyclotron. Axial injection was selected for the U-120M cyclotron. (INIS)

6114 ACCELERATOR-SYSTEM SOLUTIONS FOR ELECTRON-BOMBARDMENT ION SOURCES. Kaufman, H. R. Paper 75-430. New York; American Institute of Aeronautics and Astronautics (1975). 16p.

From 11th electric propulsion conference; New Orleans, Louisiana (19 Mar 1975).

Over 300 space-charge-flow solutions were obtained on a digital computer. Results are presented in both tabular and generalized graphical form for a wide range of geometries and operating conditions. Among the specific conclusions are: (1) crossover is unlikely to be the cause of high impingement ratios at low beam currents; (2) focusing is generally improved as the deceleration voltage, the accelerator thickness, and the accelerator hole diameter are all reduced (assuming no direct interception for the latter); and (3) use of a grounded decelerator generally improves focusing, but this improvement becomes negligible as the backstreaming limit is approached. (auth)

Ion Optics and Field Calculations

Refer also to abstracts 5737, 5738, and 6083.

6115 (CONF-750947-, pp 38-40) RING LENS FOR PRODUCING UNIFORM DENSITY ION BEAMS. Johnson, C. H. (Oak Ridge National Lab., TN). Sep 1975.

From symposium on experimental methods for charged-particle irradiations; Gatlinburg, Tennessee, USA (30 Sep 1975).

In experimental methods for charged-particle irradiations. (Atomics International Div., Canoga Park, Calif. (USA)).

Frequently one needs to irradiate a circular target uniformly with a positive ion beam from an accelerator. The typical beam is peaked on the axis and has a more or less Gaussian radial distribution, so that it would be advantageous to be able to fold the tails of the Gaussian inward to give a uniform flux on the target. A lens, which is quite unconventional, was designed and built for that purpose and has operated successfully for many months on the 5 MV electrostatic accelerator at this laboratory. The general concepts and lens structure are presented here. (auth)

6116 (JINR-R9-7339, pp 75-81) AUTOMATIC TEST BED FOR MEASURING THE CYCLOTRON MAGNETIC FIELD CHARACTERISTICS. Vasilevskaya, D. P.; Vasilenko, A. T.; Denisov, Yu. N.; Denisova, L. G.; Ivashkevich, S. A.; Shishlyannikov, P. T. (Joint Inst. for Nuclear Research, Dubna, USSR). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Special features of the apparatus for measuring the characteristics of the magnetic field of the U-120M isochronous cyclotron and a method for making the measurements are considered. The main measuring instrument is a magnetometer with a Hall data unit. The measurement results are recorded on punched tape. For control measurements in the periodic calibration of the Hall data unit there is a nuclear magnetometer with automatic adjustment and a specialized frequency meter. (INIS)

6117 (JINR-R9-7339, pp 247-253) TIME MEASUREMENT OF GAMMA SPECTRA ON A CYCLOTRON BEAM. Vehnos, D.; Maly, L. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Methods of time measurement for an accelerator beam in determining the lifetime of excited states and magnetic g factors are considered. The possibilities of using the U-120M isochronous cyclotron for such measurements are analyzed. (INIS)

6118 SYNCHROTRON AND UNDULATOR RADIATION OF THE FIAN [PHYSICS INSTITUTE OF ACADEMY OF SCIENCES] "PAKH" ACCELERATOR AND MEANS FOR USING IT. Alferov, D. F.; Belovintsev, K. A.; Keldysh, L. V.; Mikhailin, V. V.; Tamm, E. I.; Cherenkov, P. A. Tr. Fiz. Inst., Akad. Nauk SSSR; 80: 125-139(1975). (In Russian).

Possible uses are discussed for the synchrotron and undulator radiation from an electron synchrotron, including studies in solid-state, molecular and atomic physics, biology, and chemistry. The proposed parameters of the radiation from this synchrotron are reported, and it is shown that the introduction of local bending of the orbit of the particles, resulting in a quasi-cumulative regime of operation, will permit overlapping of the wavelength ranges from 0.1 to 5000 Å and will significantly increase the radiation intensity. The possibility is also considered of using the undulator for increasing the intensity and for improving the spectral characteristics of the radiation in a given range of wavelengths. Vacuum optical channels for experiments using synchrotron radiation are described. (40 references) (tr-auth)

6119 UNDULATOR RADIATION. Alferov, D. F.; Bashmakov, Yu. A.; Bessonov, E. G. Tr. Fiz. Inst., Akad. Nauk SSSR; 80: 100-124(1975). (In Russian).

The radiation of relativistic particles in an undulator — equipment in which a periodic electromagnetic field is formed — was studied. General formulas were derived which can be used for calculating spectra and polarization of radiation, and spectral and angular characteristics of the particle radiation in different undulators were studied. The existence of an optimum value of field magnitude in the undulator was shown, and the radiation of the relativistic

particles in a field of intensive plane waves was compared with that in a static electromagnetic field. The radiation of relativistic particles in a crystal agreed qualitatively with the results obtained from quantum calculations. The basic properties of undulator radiation in a medium were studied for the simple case of spiral particle motion. (44 references) (tr-auth)

6120 EXPERIMENTAL STUDY OF RADIATION AND DISPERSION OF LIGHT BY RELATIVISTIC ELECTRONS. Kulikov, O. F. Tr. Fiz. Inst., Akad. Nauk SSSR; 80: 3-99(1975). (In Russian).

The main properties of synchrotron radiation, especially angular dispersion and polarization, are discussed in detail. The effect of synchrotron radiation on the dynamics of movement of electrons in cyclic accelerators and the use of this radiation for studying resonances of electron oscillations in synchrotrons are analyzed. The last chapter discusses the properties of photons dispersed as a result of collision of a laser beam and an internal electron beam in the synchrotron. Special attention is given to the polarization properties of the secondary photon beam. (363 references) (tr-auth)

6121 DESIGN AND CONSTRUCTION OF A SUPERCONDUCTING QUADRUPOLE MAGNET FOR KEK BEAM CHANNEL. Hirabayashi, H.; Doi, Y.; Ishihara, N.; Maki, A.; Sato, T.; Tsuchiya, K. (KEK National Lab. for High Energy Physics, Ibaraki, Japan). pp 395-398 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The design and construction of a superconducting Panofsky quadrupole magnet for KEK beam channel are discussed. The results of magnetic field calculation with LINDA (KEK version) program are reported. The magnet has a 50 cm long iron frame and high current density coils of NbTi multi-cored superconductor. The iron frame is immersed in liquid helium with the coils. An aperture of 20 cm dia is surrounded with liquid nitrogen temperature wall. Designed field gradient is 1.6 kG/cm at 1000 A excitation. A test experiment is now under progress. (auth)

Storage Rings

6122 PHYSICS WITH COLLIDING PROTON BEAMS. Sens, J. C. (Foundation for Fundamental Research on Matter, Utrecht). pp 767-783 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The basic characteristics of the CERN ISR (Intersecting Storage Rings) are discussed with respect to: (1) energy and intensity of stored protons; (2) beam luminosity; (3) beam acceptance; (4) beam injection; (5) beam stacking; (6) beam optics; (7) beam-gas interactions; and (8) beam monitoring. (PMA)

6123 PRELIMINARY DESIGN FOR TRISTAN, TRI-RING INTERSECTING STORAGE ACCELERATORS IN JAPAN. Kikuchi, K. (National Lab. for High Energy Physics, Ibaraki, Japan). pp 514-516 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A preliminary study on the future project of the Japanese 12 GeV proton synchrotron is reported, in which superconducting magnets are used for intersecting storage accelerating rings. (auth)

Experimental Facilities

6124 (BNL-20518) PRODUCTION OF NEUTRONS AND SECONDARY PROTONS WITH PARTICLE ACCELERATORS. Kukkonen, J. 1973. Translation of Sekundaarineutronien ja-protonien tuottaminen hiukkaskiihdyttimillae. 350p. Dep. NTIS $10.00.

Thesis.

Methods of producing fast neutrons and secondary protons are discussed, and related information, such as yields and target temperatures, is included. To widen the use of small electrostatic accelerators, the possibility of producing 15-MeV protons is treated. The fraction of the particles emitted by the source which hit a plane sample (the hitting efficiency) was determined in a computer calculation for several geometries. Fast neutron production with accelerators operating at energies greater than 20 MeV is discussed, and new target concepts are introduced. (PMA)

6125 (CONF-751115-2) DESIGN OF THE FERMILAB REMOTE TARGET MAINTENANCE SYSTEM. Simon, J.; Grimson, J.; Lindberg, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Jul 1975. 31p. Dep. NTIS $4.50.

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975)..

A system of interchangeable targetry on rail transporters, in use for four years, is described. The design concept allows rapid interchange of radioactive target equipment with a minimum of exposure to operating personnel. Separate maintenance facilities, equipped with a variety of remote handling equipment including a mobile electric master slave manipulator, are used to construct, maintain, and modify targetry and beam line equipment concurrent with the 400 GeV accelerator beam operation. (auth)

6126 (CONF-751115-4) DESIGN OF THE FERMILAB NEUTRINO HORN TRAIN SYSTEM REFERENCED TO RADIOACTIVE MAINTENANCE. Grimson, J.; Lindberg, J.; Simon, J.; Theriot, D. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Jul 1975. 40p. Dep. NTIS $5.00.

From 23rd conference on remote systems technology; San Francisco, California, USA (16 Nov 1975).

A high energy physics device known as a Horn, operating at 140,000A and 8 kV, has unique servicing problems after being exposed to 300-400 GeV protons at 1-5 x 10^{13} protons/pulse. A modular system consisting of two horns, one cooled by a pulsed water spray, the other by forced air cooling, along with their associated utilities and instrumentation, were designed for primary servicing using Electric Master Slave Manipulators and TV viewing. (auth)

6127 (JINR-R9-7339, pp 170-174) POLARIZED PROTON TARGET FOR LOW ENERGIES. Burget, J.; Odegnal, M.; Petrzhichek, V.; Shakha, J.; Tikhi, R. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

A polarized proton target designed for measuring the spin-correlation parameter during scattering of polarized neutrons with energies of 15 to 18 MeV is described. The target is made from a $La_2Mg_3(NO_3)_{12}.24H_2O$ monocrystal with a paramagnetic admixutre of 0.5% Nd^{3+}. The parameters of the target are given. (INIS)

6128 (JINR-R9-7339, pp 286-297) MULTIANGULAR MAGNETIC ANALYZER FOR NUCLEAR REACTION PRODUCTS AT THE INSTITUTE OF NUCLEAR PHYSICS OF THE CZECHOSLOVAKIAN ACADEMY OF SCIENCES. Frants, P.; Piskorzh, S.; Krzhemenek, Ya. (Ustav Jaderne Fyziky, Rez, Czech.). 1973. (In Russian).

From 3rd symposium on the isochronous cyclotron U-120M and its uses for studies on nuclear physics; Ceske Budejovice, Czechoslovakia (14 May 1973). (Joint Inst. for Nuclear Research, Dubna (USSR)).

Special features are described of the magnetic analyzer for the products of nuclear reactions, consisting of 11 identical spectrographs, located in fan shape around the center, where the target is placed. The analyzed particles are recorded on a photographic plate. The principle of the operation of experimental equipment with a magnetic analyzer is described. (INIS)

6129 SUBCOOLED CRYOGENIC TARGETS. Buhler, S. (Institut de Physique Nucleaire, Orsay, France). pp 553-555 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Some experiments in nuclear physics require targets which are able to dissipate several watts in the cryofluid without bubble formation. Two experimental devices are described: (1) a LHe-cooled liquid hydrogen target with power dissipation up to 15 W; and (2) an apparatus for LHe^4 and LHe^3 targets which combines a LHe bath cryostat with a subcooled target loop and an economizer cycle. The optimum performance of the economizer cycle under standard conditions is discussed. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Refer also to abstract 6379.

Cosmic Radiation

Refer also to abstracts 6191, 6194, 6195, 6260, 6339, 6340, 6346, 6351, 6394, 6397, and 6450.

6130 (CEA-CONF-3078) INVERSE COMPTON PRODUCTION OF GAMMA RAYS IN INTERSTELLAR SPACE. Shukla, P. G.; Casse, M.; Cesarsky, C. J.; Paul, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 5p. (CONF-750805-20). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

The longitude distribution of gamma rays of energy >100 MeV produced by the inverse Compton interaction in the galaxy is calculated. Cosmic ray electron density is considered either uniform throughout the galactic plane, or varying in accordance with the model of Paul et al. (1974). Stellar photon intensity is estimated using models of mass distribution in the galactic nucleus and the disc. Contribution of the 2.7°K black-body radiation is included. It is found that the calculated gamma ray flux from the galactic center direction is lower than that measured by the SAS II satellite by an order of magnitude. (auth)

6131 (CEA-CONF-3080) TIME DELAY BETWEEN THE NUCLEOSYNTHESIS OF COSMIC RAYS AND THEIR ACCELERATION TO RELATIVISTIC ENERGIES. Soutoul, A.; Casse, M.; Juliusson, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1975. 4p. (CONF-750805-19). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

The time delay δt between the nuclosynthesis of the elements observed in the cosmic rays and the onset of their acceleration is of critical importance for the discussion of the origin of the cosmic radiation and will affect its composition. We invoke the Fe, Co and Ni isotopes to illustrate this point. The presence of iron group nuclei in the galaxy is believed to be mainly due to explosive nucleosynthesis. This process does not produce iron directly, but the proton rich progenitors ^{56}Ni and ^{57}Ni. If these isotopes survive the ejection from the exploding star they decay to their stable isobar. ^{57}Ni decays quickly to ^{57}Co, ^{56}Ni and ^{57}Co can only decay to ^{56}Fe and ^{57}Ni via electron capture with a half life of 6.1 days and 270 days respectively. If the cosmic rays are accelerated to relativistic energies quickly after their synthesis, these decay modes are prevented, leading to large differences in the Ni/Fe and Co/Fe ratio in the cosmic rays and the solar system abundances. From existing data on the nickel, cobalt and iron abundances in the cosmic rays we conclude that more than a few weeks and most likely more than a year elapses between the synthesis of the cosmic ray nuclei and their acceleration. (auth)

6132 (CEA-CONF-3081) POSITRON AND ANTIPROTON ABUNDANCES AS A TEST FOR COSMIC RAY PROPAGATION MODELS. Lachieze-Rey, M.; Cesarsky, C. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 6p. (CONF-750805-18). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

The observed variations with energy of the ratio L/M for cosmic rays with energy in the range 1 to 100 GeV/nucl. are well accounted for by three kinds of models: cosmic rays are trapped in the galaxy, where their mean path length is energy dependent; cosmic rays are trapped in their sources, and escape from them in an energy dependent fashion. The mean galactic path length is energy independent (Meneguzzi, 1973); high energy cosmic rays spend less time in dense clouds than low energy cosmic rays. The positron and antiproton fluxes predicted by these models are discussed. (auth)

6133 (CEA-CONF-3082) ^{36}Cl AND THE AGE OF THE COSMIC RAYS. Casse, M.; Goret, P.; Regnier, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 5p. (CONF-750805-17). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

An attempt is made to use the radioactive isotope ^{36}Cl ($\tau = \gamma \times 3.10^5$y) as a time reference for the propagation of cosmic rays. New measurements of the production cross section of ^{36}Cl in Ti and Fe at 24 GeV will be presented. A critical analysis of the cross sections leads to an estimate of the ratio ^{36}Cl/Cl = 0.030 ± 0.007 in the arriving cosmic rays. The comparison between the expected abundance of Cl in the arriving cosmic rays and the observations tend to support the decay of ^{36}Cl. The inferred cosmic ray confinement time is about 10^6y. (auth)

6134 (CEA-CONF-3083) GALACTIC LIGHT ISOTOPES: SIGNIFICANCE OF THE PRESENT OBSERVATIONS. Meyer, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 6p. (CONF-750805-16) Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

All the existing observations which did resolve low energy deuterons and He^3's appear to form a self-consistent set with a hysteresis type of variation over the solar cycle of the ratio $\phi_d/\phi_{He}4^*$, where $\phi_{He}4^*$ is the He^4 flux corrected for the "anomalous" low energy component. This hysteresis can be understood if one accepts an interplanetary deceleration which is weak during the rising phase, and strong during the recovery phase of the solar cycle, and a continued increase of the escape length from the galaxy below a few GeV/n. (auth)

6135 (CEA-CONF-3084) INTERSTELLAR PROPAGATION OF LOW ENERGY COSMIC RAYS. Cesarsky, C. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 5p. (CONF-750805-15). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

Wave particles interactions prevent low energy cosmic rays from propagating at velocities much faster than the Alfven velocity, reducing their range by a factor of order 50. Therefore, supernovae remnants cannot fill the neutral portions of the interstellar medium with 2 MeV cosmic rays. (auth)

6136 (CEA-CONF-3085) ATOMIC PROPERTIES OF THE ELEMENTS AND COSMIC RAY COMPOSITION AT THE SOURCE. Casse, M.; Goret, P.; Cesarsky, C. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 6p. (CONF-750805-14). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

Possible correlations between the abundances of cosmic rays at the source and the solar system abundances are discussed. It is shown that cosmic ray source abundances could be explained if the particles are accelerated to injection energies in a dilute, moderately hot plasma, from which they escape in a rigidity dependent fashion. (auth)

6137 (CEA-CONF-3086) SOURCE COMPOSITION OF COSMIC RAYS AT HIGH ENERGY. Juliusson, E.; Cesarsky, C. J.; Meneguzzi, M.; Casse, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 6p. (CONF-750805-13). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

The source composition of the cosmic ray is usually calculated at an energy of a few GeV per nucleon. Recent measurements have however indicated that the source composition may be energy dependent. In order to give a quantitative answer to this question the source composition at 50 GeV/nucleon has been calculated using an exponential distribution of pathlengths and in the slab approximation. The results obtained at high energy agree very well with the source composition obtained at lower energies, except the abundance of carbon which is significantly lower than the generally accepted value of low energies. (auth)

6138 (CEA-CONF-3091) COMPOSITION OF COSMIC RAYS AT 10^{10} TO 10^{13} eV/NUCLEUS. Juliusson, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1975. 6p. (CONF-750805-11). Dep. NTIS (US Sales Only) $4.00.

From 14th international cosmic ray conference; Munich, F. R. Germany (15 Aug 1975).

The nuclear composition of the cosmic rays around 10^{10}-10^{13} eV total energy per nucleus has been calculated from recent counter measurements. The abundance of iron in the highest energy range is comparable to the abundance of protons and alpha particles, and increasing with energy. If this trend continues, the highest energy airshower events recorded are caused mostly

by iron nuclei, and we cannot be sure of their extragalactic origin. (auth)

6139 (NASA-SP-361) SIGNIFICANT ACCOMPLISHMENTS IN SCIENCE AND TECHNOLOGY. Proceedings of a Symposium Held in Greenbelt, Maryland, December 18–19, 1973. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). 1975. 348p. (CONF-731232-; N-75-16422). Dep. NTIS $10.00.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

The symposium consisted of 106 papers discussing results of various NASA research programs. Separate abstracts are prepared for 24 papers within the subject scope of NSA. (CES)

For abstracts of individual papers see: 6140–6150, 6169, 6170, 6178–6181, 6219, 6220, and 6244–6248.

6140 (NASA-SP-361, pp 36-39) COSMIC GAMMA-RAY BURSTS: NASA OBSERVATIONS AND THEIR IMPLICATIONS. Cline, T. L. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Observations of cosmic gamma bursts are reported and the hard x-ray or soft gamma-ray nature of the incident flux is established. (BJG)

6141 (NASA-SP-361, pp 40-43) UNIQUENESS OF THE ENERGY SPECTRUM OF COSMIC GAMMA-RAY BURSTS, AS OBSERVED BY IMP-6. Desai, U. D. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Cosmic gamma bursts observed by IMP-6 are due to photons. Some of the interesting features, such as double pulsation, are confirmed and a differential energy spectra in the 100 to 1200 KeV range is provided. (BJG)

6142 (NASA-SP-361, pp 44-47) COOLING BLACKBODY: A MECHANISM FOR COSMIC GAMMA-RAY BURSTS. Ramaty, R. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

A model is proposed which accounts for most of the observed features of cosmic gamma-ray bursts. The formation of neutron stars is suggested as the origin of gamma-ray bursts. (BJG)

6143 (NASA-SP-361, pp 48-51) HIGH ENERGY DIFFUSE GAMMA RAYS: EXPERIMENTAL RESULTS AND THEORETICAL INTERPRETATION. Thompson, D. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Measurements of the diffuse gamma spectrum taken by SAS-2 are presented. The origin of the gamma rays is discussed. (BJG)

6144 (NASA-SP-361, pp 52-55) SAS-2 HIGH ENERGY GAMMA-RAY OBSERVATIONS OF GALACTIC STRUCTURE AND THE CRAB NEBULA. Kniffen, D. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Preliminary results from experiments conducted with SAS-2 on the radiation from the galactic plane are presented. Two regions of the galactic plane are studied: one, a 90^0 interval in galactic longitude in the region of the galactic center, and the other, from 160^0 to 230^0 in longitude, directly away from the galactic center. (BJG)

6145 (NASA-SP-361, pp 56-59) THEORETICAL INTERPRETATION OF THE SAS-2 HIGH ENERGY GAMMA-RAY OBSERVATIONS OF THE GALACTIC PLANE IN TERMS OF THE GALACTIC COSMIC-RAY AND MATTER DISTRIBUTIONS. Fichtel, C. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Gamma-ray data from SAS-2 is analyzed. It is suggested that enhanced gamma radiation in the arm segments of the galaxy is due to the interaction of cosmic rays with the matter in the galactic arms. (BJG)

6146 (NASA-SP-361, pp 60-62) GAMMA-RAY EVIDENCE FOR GALACTIC FERMI ACCELERATION OF COSMIC RAYS. Stecker, F. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

New information on the distribution of cosmic rays in the galaxy is provided by SAS-2 galactic gamma-ray data. The observed gamma-ray energy spectrum reveals that about 70 percent of the radiation in the central galactic region arises from the decay of neutral pi mesons produced by cosmic ray nucleon interactions with the interstellar gas. (BJG)

6147 (NASA-SP-361, pp 71-74) X-RAY ASTRONOMY EVIDENCE FOR SUBRELATIVISTIC COSMIC RAYS FROM SUPERNOVAE. Boldt, E. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

X-ray observations reveal the evidence to be expected for young subrelativistic cosmic rays still in the immediate vicinity of their supernova origins. (BJG)

6148 (NASA-SP-361, pp 80-83) PIONEER-10 MEASUREMENTS OF THE COMPOSITION OF LOW ENERGY GALACTIC COSMIC RAYS. Teegarden, B. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Dramatic changes in the composition of cosmic rays at low energies indicate evidence for the existence of a new type of source for cosmic rays. Measurements of the cosmic-ray energy and charge spectra in the charge range of 2 to 14 are discussed. (BJG)

6149 (NASA-SP-361, pp 84-87) WHAT PIONEER-10 MEANS TO COSMIC-RAY MODULATION THEORY. Fisk, L. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The problem of how low energy cosmic-ray particles, assumed to be galactic in origin, get into the inner solar system is discussed. It is concluded that adiabatic cooling is not as important as was previously thought, and local modulation is controlled by conditions out of the ecliptic plane. (BJG)

6150 (NASA-SP-361, pp 88-91) BALLOON OBSERVATIONS OF COSMIC-RAY NEGATRONS AND POSITRONS. Hartman, R. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The absolute modulation of positrons in the energy range 20 to 500 MeV is deduced from a measurement of the interplanetary positron spectrum. The energy loss, or cooling, predicted by modulation theory, can be directly observed by studying the time variations in the positron-negatron ratio. (BJG)

6151 CHARACTERISTICS OF ENERGETIC COSMIC-RAY MUONS EXPECTED FOR TWO NUCLEON–NUCLEUS INTERACTION MODELS. Goned, A. (Univ. of Durham). Nuovo Cim.; 29A: No. 3, 301-316(1 Oct 1975).

The results of calculations on the expected characteristics of cosmic-ray muons generated by primary nucleons are given for two models of nuclear interactions: the "old" CKP model and the "new" scaling model. The calculations relate to near-vertical muons and muons at 60° to the vertical. The parameters studied include the muon intensity, the density as a function of distance from the axis of the initial primary nucleon and the mean height of origin, all as a function of muon threshold energy and energy

of primary nucleon. The results are compared with similar contemporary calculations. (auth)

6152 FLUCTUATIONS OF SOLAR COSMIC RAYS INTENSITY. Dorman, L. I.; Kats, M. E. pp 311-321 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

A fluctuation of intensity of charged particles in the interplanetary medium with both regular and accidental components is considered. (auth)

6153 INSTRUMENTAL TECHNIQUE IN X-RAY ASTRONOMY. Peterson, L. E. (Univ. of California, San Diego, La Jolla). Annu. Rev. Astron. Astrophys.; 13: 423-509 (1975).

This review is confined to nonfocusing, high-sensitivity counter techniques used in the detection of cosmic photons in the 0.20 to 300 keV range. The status of x-ray astronomy, photon interactions, detector principles and applications, sensitivity considerations, radiation environment, and contemporary instruments are discussed. (42 figures, 175 references) (BJG)

6154 PRIMARY COSMIC RAY SPECTRUM FROM 10^{11} eV TO 10^{15} eV. Gerdes, C. B. Tucson, AZ; Univ. of Arizona (1974). 101p. University Microfilms Order No. 75-11,911.

Thesis (Ph. D.).

During the moonless nights of April, May, and June 1973, a measurement was made of the differential energy spectrum of primary cosmic ray particles of energies between 10^{11} ev and 10^{15} ev. Based on limited experimental information, it has been speculated that, in this energy range, either due to the increasing importance of the p-p collisional process or due to the change of the confinement parameters for cosmic ray particles in the galaxy, the energy spectrum may exhibit a pronounced deviation from that of lower energies. The object of this work was to measure the spectral shape to higher accuracy searching for this feature. The measurement was made by detecting the Cherenkov light components of air showers caused by the interaction of the primary cosmic rays and the atmosphere. The experimental results indicate that the spectrum, in this energy range, can be expressed as J/E/sup 2,4 + 0,1/. No kink such as the one obtained by the Proton series of satellites was found. No explanation of this disagreement is offered here. The results are in general agreement with the conclusions of Gaisser and his co-workers that the energy dependence of the pp collisional cross section has little effect on the spectrum in this energy range. (Diss. Abstr. Int., B)

Stars

Refer also to abstracts 6142, 6147, 6169, 6199, 6202, 6322, 6578, 6579, 6641, 6651, 6653, and 6654.

6155 WHITE DWARF EXTERNAL LAYERS. I. Convection and Central Temperatures. D'Antona, F. (Osservatorio Astronomico, Rome); Mazzitelli, I. Astron. Astrophys.; 42: No. 2, 165-172(Aug 1975).

Several models for white dwarf atmospheres and subatmospheres have been computed for various physical and chemical conditions. It is shown that the equation of state is probably the most critical parameter in determining the structure of the inner layers. (auth)

6156 DYNAMICS OF ROTATING STELLAR SYSTEMS: COLLAPSE AND VIOLENT RELAXATION. Gott, J. R. III (California Inst. of Tech., Pasadena). pp 181-190 of Formation and Dynamics of Galaxies. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the symposium on formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

Axisymmetric systems, having differing amounts of initial angular momentum and containing 2000 stars (mass points) each, are allowed to collapse under their own gravitational attraction. Collapse and violent relaxation are found to lead to the formation of equilibrium structures after only a few free-fall times. The systems contain a sufficient number of mass points so as to be effectively collisionless, and the equilibrium structures are consistent with accurate satisfaction of the stationary collisionless Boltzmann equation. Rotating equilibrium models produced in this way resemble elliptical galaxies, with elliptical isophotes. The equilibrium models show rotation curves in general agreement with that expected from violent relaxation theory. In particular, the models show a central region with solid-body rotation. Further out, the systems become differentially rotating. When infall effects are included one can produce models with extended envelopes in good agreement with observed elliptical galaxies. It is suggested that the crucial factor in determining whether an elliptical or a spiral galaxy is formed is whether or not star formation is complete by the time the proto-galaxy reaches its point of maximum collapse. (auth)

6157 NEUTRINO PROCESSES IN STELLAR INTERIORS. Barkat, Z. (Hebrew Univ., Jerusalem). Annu. Rev. Astron. Astrophys.; 13: 45-68 (1975).

This review is a discussion of the role of neutrinos in different relevant epochs of stellar evolution. Section one outlines the basic theoretical and experimental work. Section two is devoted to the effects of neutrino losses on late stages of stellar evolution in general. The evolution of stars in a special but important mass range 4 less than or approximately equal to M/solar mass less than or approximately equal to 10 (where pulsars might be formed) is discussed in Section three. Section four deals with the dynamical collapse of stellar cores during which the special aspect of neutrinos activity, that is, their interaction with outer layers, appears. The cooling of neutron stars is reviewed in Section five. Concluding remarks are given in Section six. (120 references) (BJG)

6158 THERMONUCLEAR REACTION RATES. II. Fowler, W. A.; Caughlan, G. R.; Zimmerman, B. A. (California Inst. of Tech., Pasadena). Annu. Rev. Astron. Astrophys.; 13: 69-112 (1975).

A revision and updating of charged particle reactions involving nuclei with A less than or approximately equal to 30, except for the ^{2}H (d,gamma) ^{4}He reaction whose reaction rate is very uncertain, is presented. Reactions involving neutrons are treated as neutron-producing reactions but factors for calculating the reverse reaction rate are provided for all reactions. The rates of the (n,gamma) reactions given previously have not been revised. The Maxwell-Boltzmann distribution is assumed to hold for the relative velocities of the interacting particles. (40 references) (BJG)

6159 YOUNG STELLAR OBJECTS AND DARK INTERSTELLAR CLOUDS. Strom, S. E.; Strom, K. M.; Grasdalen, G. L. (Kitt Peak National Observatory, Tucson, AZ). Annu. Rev. Astron. Astrophys.; 13: 187-216 (1975).

This review synthesizes current observational knowledge concerning pre-main-sequence evolution and the interaction of pre-main-sequence stars with their dark cloud environment. Questions of current interest are raised and the direction of future fruitful research is discussed. (80 references) (BJG)

6160 UNSEEN ASTROMETRIC COMPANIONS OF STARS. van de Kamp, P. (Univ. of Amsterdam). Annu. Rev. Astron. Astrophys.; 13: 295-333 (1975).

The available information is presented on unseen companions of stars, revealed either as unresolved astrometric binaries that have been found and studied from perturbations in the proper motion of a star previously considered single, or as an irregularity in the orbital motion of a visual double star, which thus proves to have a third component. The astrometric method is used as it is particularly suited for the discovery and subsequent study of perturbations with long periods and large amplitudes. A list is given of well-established as well as of provisional and uncertain results. (5 tables, 75 references) (BJG)

6161 EQUATION OF STATE AT ULTRAHIGH DENSITIES. II. Canuto, V. (Goddard Space Flight Center, New York). Annu. Rev. Astron. Astrophys.; 13: 335-380 (1975).

A review is presented of the work done to date in the high density region 10^4 less than or equal to rho less than or equal to 2 x 10^{14} g cm^{-3}. Hyperons at densities higher than nuclear density and their influence on the equation of state are discussed. The disagreement in the predicted value for the velocity of sound in the relation P equals c^2/sub s/epsilon in the superhigh-density region is examined. The available data regarding neutron stars, in particular the moment of inertia, are shown to be insufficient to pin down a specific value of the velocity of sound at superhigh densities. (8 tables, 75 references) (BJG)

6162 ASTROPHYSICAL PROCESSES NEAR BLACK HOLES. Eardley, D. M. (Yale Univ., New Haven). Annu. Rev. Astron. Astrophys.; 13: 381-422 (1975).

A review is given of black hole formation and astrophysical processes near black holes. The following topics are discussed: gravitational collapse, interactions of the hole with its environment, black holes in binary systems, and exotic possibilities. (200 references) (BJG)

6163 PULSAR EMISSION MECHANISMS. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow); Zheleznyakov, V. V. Annu. Rev. Astron. Astrophys.; 13: 511-535 (1975).

A review of pulsar-emission mechanisms is presented. Topics discussed include the pulsar magnetosphere, mechanisms of electromagnetic radiation, formation of the radiation polar diagram, mechanisms of pulsars' radio emission, and mechanism of optical, x-ray and gamma-ray emission of the pulsar in the Crab. (80 references) (BJG)

6164 ADVANCED EVOLUTION OF A 15 SOLAR MASS STAR. Endal, A. S. Gainesville, FL; Univ. of Florida (1974). 256p. University Microfilms Order No. 75-16,378.

Thesis (Ph. D.).

The evolution of a 15 solar mass star has been followed from the zero-age main sequence to the neon-ignition phase by use of the Henyey method for solving the equations of quasi-hydrostatic evolution. The detailed results of nucleosynthesis during carbon burning were calculated by a second-order, backwards-differencing scheme, with the effects of convection included in an approximate manner. The results of the evolution calculations and of the nucleosynthesis calculations are described and a detailed analysis of the effects of convection on nucleosynthesis is presented. The quiescent nature of evolution through the hydrogen, helium, and carbon burning stages is confirmed. Comparison with previous studies of the post-carbon burning evolution of massive stars shows that calculations in which degeneracy is neglected will not yield realistic results. (Diss. Abstr. Int., B)

6165 FORMATION OF A CONTACT BINARY STAR SYSTEM. Mullen, E. F. F. Gainesville, FL; Univ. of Florida (1974). 154p. University Microfilms Order No. 75-16,425.

Thesis (Ph. D.).

The process of forming a contact binary star system is investigated in the light of current knowledge of the W Ursae Majoris type eclipsing binaries and the current rotational braking theories for contracting stars. A preliminary stage of mass transfer is proposed and studied through the use of a computer program which calculates evolutionary model sequences. The detailed development of both stars is followed in these calculations, and findings regarding the internal structure of the star which is receiving the mass are presented. Relaxation of the mass-gaining star is also studied; for these stars of low mass and essentially zero age, the star eventually settles to a state very similar to a zero-age main sequence star of the new mass. A contact system was formed through these calculations; it exhibits the general properties of a W Ursae Majoris system. The initial masses selected for the calculation were 1.29 M/sub solar mass/ and 0.56 M/sub solar mass/. An initial mass transfer rate of about 10^{-10} solar masses per year gradually increased to about 10^{-8} solar masses per year. After about 2.5×10^7 years, the less massive star filled its Roche lobe and an initial contact system was obtained. The final masses were 1.01359 M/sub solar mass/ and 0.83641 M/sub solar mass/. The internal structure of the secondary component is considerably different from that of a main sequence star of the same mass. (Diss. Abstr. Int., B)

6166 HYDRODYNAMIC MODELS OF A CEPHEID ATMOSPHERE. Karp, A. H. College Park, MD; Univ. of Maryland (1974). 195p. University Microfilms Order No. 75-17,885.

Thesis (Ph. D.).

A method for including the solution of the transfer equation in a standard Henyey type hydrodynamic code has been developed. This modified Henyey method has been used in an implicit hydrodynamic code to compute deep envelope models of a classical Cepheid with a period of 12 d including radiative transfer effects in the optically thin zones. There are two secondary features on the light curve of the model, a shoulder during rising light and a distinct bump during falling light. It is shown that the shoulder during rising light is caused by a deep envelope pressure wave and that the bump during falling light may be due to an atmospheric oscillation. It is shown that the atmospheric oscillation mechanism is consistent with the Hertzsprung sequence and the period-luminosity relation. The structure of each hydrodynamic model was used as a snapshot of the temperature and pressure structure of the atmospheric layers. Line profiles were then computed using the moving atmospheres from the hydrodynamic models. It was found that the velocity gradients in the atmosphere are not responsible for the large microturbulent velocities observed in Cepheids but may be responsible for the occurrence of supersonic microturbulence. The adopted light, color, and velocity curves were used to study three methods frequently used to determine the mean radii of Cepheids. It was found that an accuracy of 10 percent is possible only if high quality observations are used. (Diss. Abstr. Int., B)

6167 GRAVITATIONAL OPTICS: A STUDY OF NULL GEODESICS AND GRAVITY WAVES IN THE GEOMETRY PRODUCED BY A STAR. Cyranski, J. F. Milwaukee; Univ. of Wisconsin (1974). 167p. University Microfilms Order No. 75-17,804.

Thesis (Ph. D.).

This thesis presents the theory of scattering of neutrinos and of gravity radiation by the weak gravitational field of a spherically symmetric star, with emphasis on penetration of the star by the radiation. Using null-geodesics (ray tracing) for neutrinos and high frequency gravity waves, one discovers caustics, foci, and an axicon effect. It is possible to use these optical phenomena (provided they can be empirically located) to find the stellar density function, rho(r). It is shown that these results apply to frequencies of gravity radiation too high to be expected to occur naturally, so a wave optics is developed. Einstein's solutions for a non-trivial background metric are perturbed, and the resultant equations are solved assuming a linear expansion of the background and a distorted-wave Born approximation. (Diss. Abstr. Int., B)

6168 INTERACTIONS OF FREE ELECTRONS WITH ELECTROMAGNETIC RADIATION. Zel'dovich, Ya. B. (Inst. of Applied Mathmatics, Moscow). Usp. Fiz. Nauk; 115: No. 2, 161-197(Feb 1975). (In Russian)

The interaction of a chaotic field of electromagnetic radiation with free electrons of a plasma applicable to astrophysical problems, in particular to the theory of establishment of thermodynamic equilibrium of radiation in a hot universe, is considered. A kinetic equation describes the change in spectrum; special attention is given to induction scattering and classical interpretation of induction transmission of energy and momenta. In the spectrum of radio sources with a high luminosity temperature, induction scattering may lead to Bose condensation of photons, shock waves, and the appearance of solitons. Scattering of strong low frequency waves are considered applicable to the effect of pulses and laboratory coherent generators. (tr-auth)

Quasi-Stellar, Radio, and X-Ray Sources

6169 (NASA-SP-361, pp 63-66) CYGNUS X-1 TEMPORAL MICROSTRUCTURE: EVIDENCE FOR A BLACK HOLE. Rothschild, R. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The spectral and temporal character of three x-ray sources whose present configurations are thought to be the result of massive gravitational collapse are examined. Cygnus X-1 is viewed as the most likely candidate for a black hole. (BJG)

6170 (NASA-SP-361, pp 67-70) MULTIPLE HERCULES X-1 PERIODICITIES: A SIMPLE KINEMATIC EXPLANATION. Holt, S. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

A model is proposed to account for the multiple periodicities of Her X-1 on all time scales up to about 35 days. (BJG)

6171 5 GHz POLARIZATION OBSERVATIONS OF 33 GALACTIC RADIO SOURCES. Milne, D. K.; Dickel, J. R. (CSIRO, Epping, Australia). Aust. J. Phys.; 28: No. 1, 209-230(Feb 1975).

Polarization observations have been made of 33 galactic radio sources, mostly supernova remnants, at a frequency of 5 GHz using the 64 m telescope at Parkes. Maps of the observed polarization vectors superposed upon total intensity isotherms are presented for each source. (auth)

6172 BALLOON-BORNE HARD X-RAY STUDY OF THE SOUTHERN SKY. Guo, D.D.S. Durham, NH; Univ. of New Hampshire (1974). 206p. University Microfilms Order No. 75-12,008.

Thesis (Ph. D.).

A NaI(Tl) scintillation telescope-spectrometer with a sensitive area of 450 cm^2 and an aperture of $6^0 \times 14^0$ FWHM was designed and built for high-altitude astronomical observation in the photon energy range of 17 keV to 1.5 MeV. During an 8-hour balloon flight in Argentina on November 22, 1971, the instrument was utilized to survey the galactic plane and its vicinity between l/sup II/ equals 285^0 and l/sup II/ equals 25^0, including the galactic center. In the hard x-ray profile of the galactic plane obtained, a total of eleven sources were observed. They could be identified with sources CEN X-5, GX 301-2, GX 304-1, CIR X-1, NOR X-2, GX 340 + 0, NOR X-1, GX 349 + 2, GX 357 + 2.5, and the group of sources near the galactic center. Spectra of these sources were measured between 17 keV and 500 keV, and their corre-

sponding spectral characteristics were derived. The spectral hardness below 100 keV differs considerably in the hard x-ray spectra of the observed sources, but there seems to be no correlation of this spectral hardness with the x-ray luminosity classification of Seward et al., (1972). A search for extraterrestrial gamma ray line emission near 0.5 MeV has set an upper limit of 1.7×10^{-3} photons/cm^2 sec for most of the celestial area covered by the observation, including the galactic disk, and of $(3.2 +- 1.5) \times 10^{-3}$ photons/cm^2 sec for the galactic center region. (Diss. Abstr. Int., B)

6173 PARKES 2700 MHz SURVEY. VII. Supplementary Catalogue for the Declination Zone −4° to −30°. Bolton, J. G.; Shimmins, A. J.; Wall, J. V. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 34, 1-32(1975).

A catalogue of 348 radio sources is presented, covering right ascensions 08h00m to 17h00m and 19h30m to 06h30m between declinations −4° and −30°. The regions omitted are within ~10° of the galactic plane. The catalogue was compiled from a "fast" finding survey at 2700 MHz aimed at detecting sources stronger than 0.5 Jy. Subsequent measurements of flux density and position were made on all the sources which were not in the Parkes 408 MHz catalogue, and on some sources in the 408 MHz catalogue for which only data of low accuracy were available. Positions of the sources were determined to an accuracy of 7″ arc r.m.s. in both coordinates. Flux densities for all sources were also measured at 5009 MHz. Identifications are suggested for 50 galaxies, 100 quasi-stellar objects and 4 planetary nebulae. (auth)

6174 PARKES 2700 MHz SURVEY. VIII. Catalogue for the Declination Zone −65° to −75°. Bolten, J. G.; Butler, P. W. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 34, 33-53(1975).

A catalogue of 515 radio sources is presented for the region between declinations −65° and −75° (0.374 sr). The survey is believed to be complete to 0.22 Jy at 2700 MHz (~900 sources per steradian). Flux densities at 5009 MHz have been measured for most of the sources stronger than 0.35 Jy at 2700 MHz. (auth)

6175 PARKES 2700 MHz SURVEY. IX. Supplementary Catalogue for the Declination Zone −45° to −65°. Wall, J. V.; Shimmins, A. J.; Bolten, J. G. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 34, 55-62(1975).

A catalogue of 166 radio sources is presented, covering an area of 0.63 sr with right ascensions 00h to 03h, 04h to 08h30m, 17h30m to 19h and 20h to 23h between declinations −45° and −65°. The regions omitted are either close to the galactic plane (08h30m to 17h30m) or are covered in the third part of the Parkes 2700 MHz survey. The catalogue was compiled from a "fast" finding survey at 2700 MHz aimed at detecting sources stronger than 0.5 Jy. Subsequent measurements at 2700 and 5009 MHz of flux density and position were made for all sources which were not in the Parkes 408 MHz catalogue and for 42 sources in the 408 MHz catalogue for which only data of low accuracy were available. (auth)

6176 PARKES 2700 MHz SURVEY. X. Supplementary Catalogue for the Declination Zone +4° to +25°. Shimmins, A. J.; Bolton, J. G.; Wall, J. V. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 34, 63-83(1975).

A catalogue of 181 radio sources is presented covering the declination zone +4° to +25° and all right ascensions, omitting two regions within approximately 10° of the galactic plane (R.A. 05h30m to 07h00m and R.A. 18h00m to 20h30m). The catalogue was compiled from a "fast" finding survey at 2700 MHz aimed at detecting sources stronger than 0.5 Jy. Subsequently, measurements of accurate flux density and position were made on all the sources which were not in the Parkes 408 MHz catalogue and on a few sources in the 408 MHz catalogue for which only data of low accuracy were available. The positions of sources were determined to an accuracy of 10″ arc r.m.s. in both coordinates. Flux densities for most of the sources were also measured at 5009 MHz. Identifications are suggested for 17 galaxies and 62 quasi-stellar objects. (auth)

Solar Phenomena

Refer also to abstracts 5195, 6152, 6235, 6242, and 6273.

6177 (N-75-19113) FORBIDDEN Ca 2 IN THE SUN UNMASKED BY WAY OF VENUS. Schorn, R. A.; Yound, A. T.; Barker, E. S. (Texas Agricultural and Mechanical Univ., College Station (USA)). 14 Mar 1975. 14p. (NASA-CR−136746). NTIS $3.25.

Eleven high-dispersion spectra of Venus, taken with blue Doppler shifts have permitted the unmasking of the 7323.88A forbidden line of Ca II from terrestrial absorption. An equivalent width is obtained of 7.4 + or −0.4mA for this line in integrated sunlight. Our value of W_γ is smaller than previous values and much more accurate. The HSRA solar model gives a solar calcium abundance of $A_{Ca} = 6.21$. (STAR)

6178 (NASA-SP-361, pp 94-96) SOLAR CYCLE VARIATION OF EUV RADIATION. Chapman, R. D. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Correlations between the level of the EUV flux in various lines in the 150 to 400 A region and the solar radio flux are carried out revealing correlation coefficients significant at the 99 percent confidence level. Linear regression lines for the EUV intensities of a few lines in this wavelength region versus the radio flux are calculated. The agreement between the predicted and observed intensities is good. (BJG)

6179 (NASA-SP-361, pp 97-99) SOLAR CYCLE VARIATION OF SOLAR WIND CHARACTERISTICS. Ogilvie, K. W. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

A report on a study of the solar cycle variation of helium abundance in the solar wind is given. Both systematic and random errors associated with the measurements are considered. (BJG)

6180 (NASA-SP-361, pp 100-103) SHOCK WAVES FROM THE SUN. Burlaga, L. F. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

A model describing the propagation of shock waves through an interplanetary stream is discussed. (BJG)

6181 (NASA-SP-361, pp 104-107) RADIO TRACKING OF PARTICLES FROM THE SUN. Fainberg, J. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Observations of solar radio bursts are used to track the motion of energetic particles from regions close to the sun out to the earth's orbit. (BJG)

6182 TERMINATION OF THE SOLAR WIND IN THE HOT, PARTIALLY IONIZED INTERSTELLAR MEDIUM. Lombard, C. K. Stanford, CA; Stanford Univ. (1975). 154p. University Microfilms Order No. 75-13,553.

Thesis (Ph. D.).

Theoretical foundations of our understanding of the problem of the termination of the solar wind are reexamined in the light of most recent findings concerning the states of the solar wind and the local interstellar medium. The investigation suggests that a simple extension of Parker's (1961) analytical model provides a useful approximate description of the combined solar wind, interstellar wind plasma flowfield under conditions presently thought to occur. A linear perturbation solution exhibiting both the effects of photoionization and charge exchange is obtained for the supersonic solar wind. The solution demonstrates the point that the addition of mass and decrease of velocity as the result of photoionization in the supersonic region of the solar wind has no effect on the momentum flux and, thus, the location of the shock surface. The effect of charge exchange, however, serves to reduce by about 14 percent the estimate of the shock radius provided by Parker's solution as extended. Finally, investigation along lines of the one dimensional compressible flow equation and heating associated with polytrope solutions brings to light further theoretical evidence that the classical coefficients of thermal conductivity for an ionized gas may be too high-perhaps by as much as a factor of five-to describe the flow of the supersonic solar wind beyond earth. Derived from its roots in kinetic theory and the plasma transport equations a la Braginskii (1965), a model for the combined flow of the solar wind with the ionized component of the interstellar wind is formulated on the level of one-fluid magnetohydrodynamics. A numerical algorithm is described for computing moments of the non-equilibrium hydrogen distribution function and associated source terms for the MHD equations. (Diss. Abstr. Int., B)

6183 5 LENINGRADSKII MEZHDUNARODNYI SEMINAR MATERIALY MEZHDUNARODNOGO SEMINARA SOLNECHNYE

KOSMICHESKIE LUCHI I IKH PRONIKNOVENIE V MAGNITOSFERU ZEMLI. (Proceedings of the Fifth International Seminar on Solar Cosmic Rays and Their Penetration into the Earth's Magnetosphere held in Leningrad, June 26–29, 1973). Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). 409p. (In Russian and English).

The papers presented and discussed can be divided into five categories: generation of solar cosmic radiation and nuclear reactions on the surface of the sun, nuclear reactions in the sun's interior and solar neutrinos, solar wind, modulation and propagation of cosmic radiation, and penetration of solar cosmic radiation into the earth's magnetosphere. The papers presented in these areas are briefly reviewed in introductory remarks. Separate abstracts were prepared for 18 papers. (JSR)

For abstracts of individual papers see: 6152, 6184–6196, 6236, and 6262–6264.

6184 NEW MECHANISM OF THE MAGNETIC ENERGY TRANSFORMATION DURING THE SOLAR FLARES AND THE DISTURBANCES OF THE EARTH'S MAGNETOSPHERE. Gnedin, Yu. N.; Dolginov, A. Z.; Yakovlev, D. G. pp 27-34 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

A new mechanism for the transformation of the alternating magnetic field's energy into a plasma [I] is applied to the cosmic conditions. Owing to this mechanism the slow time variations of the magnetic field produce the intense low-frequency plasma oscillations and the oscillations heat and accelerate plasma particles. It is shown that such magnetic pumping could be realized in the solar flares. The intensity of the pumping for the mean value flare is estimated to be about 4.10^{28} erg/sec. The magnetic pumping mechanism could explain the anomalous composition of the heavy ions in the cosmic rays from some flares and the plasma heating which continues sometimes after the flare. The well established variations of the geomagnetic field could produce the magnetic pumping in the Earth's magnetosphere, the energy density of the magnetosphere low-frequency turbulence being about $2 \cdot 10^{-6}$ erg/cm^3. This figure is ten times more than the energy density of the electrons with the energy more than 40 kev and hundred times more than the energy density of the protons with the energy more than 40 mev. (auth)

6185 SOLAR HARD X-RAY AND γ-RAY BURSTS IN THE INTERPRETATION OF SOLAR COSMIC RAY ACCELERATION IN FLARES. Brown, J. C. pp 35-58 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

Recent work is reviewed on the inference of the characteristics of the solar flare cosmic ray acceleration mechanism from hard X- and γ-ray burst data. X-rays in the deka-keV range prove to be the most important of these data since they provide a means of direct observation of the electron acceleration process in situ and show that the low energy end of the cosmic ray electron spectrum carries the bulk of the cosmic ray energy, enough, in some events, to heat the thermal flare. Some aspects of the idea of flare heating by energetic particles are also reviewed. (auth)

6186 DEUTERIUM AND TRITIUM FROM SOLAR FLARES OF 10 MeV PER NUCLEON. Anglin, J. D.; Dietrich, W. F.; Simpson, J. A. pp 67-77 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

High resolution, solid-state charged particle telescopes on the Earth satellites IMP-5 and IMP-6 have made it possible to resolve all the hydrogen and helium isotopes of solar flare origin in groups of solar flares within the period September 1969 to November 1972. The average isotopic ratios, Γ, in equal energy per nucleon intervals are: Γ (^{2}H/^{1}H) = $(8 \pm 2) \times 10^{-5}$; Γ (^{3}H/^{1}H) = $(2.1 \pm 1.0) \times 10^{-5}$; and Γ (^{2}H/^{4}He) = $(1.1 \pm 0.2) \times 10^{-2}$ which can be compared with our previous result Γ (^{3}He/^{4}He) = 2×10^{-1}. It is concluded that the high yields of ^{2}H, ^{3}H (with a half life of ~12 years and, hence, of recent origin), and ^{3}He can only be explained by high energy nuclear interactions and that the acceleration process takes place in the chromosphere. (auth)

6187 SOLAR FLARE ACCELERATED ISOTOPES OF HYDROGEN AND HELIUM. Anglin, J. D.; Dietrich, W. F.; Simpson, J. A. pp 78-116 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

New measurements are reported of solar flare hydrogen, deuterium, tritium, helium-3, and helium-4 in the energy range ~10–50 MeV/nucleon obtained with University of Chicago instrumentation on the IMP-4 and IMP-5 satellites. Studies based on these results are discussed which place several constraints on theories of solar flare particle acceleration. A brief review of previous work and the difficulties in studying the rare isotopes of hydrogen and helium is also included. (auth)

6188 ABUNDANCES IN THE SOLAR WIND AND SOME APPLICATIONS TO ASTROPHYSICS AND GEOPHYSICS. Geiss, J. (Univ. of Bern). pp 117-146 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The results of measurements of the ion composition in the solar wind are summarized. For elements from H to Fe, the composition agrees within about a factor of two with the solar surface composition. Isotopic abundances in the solar wind are used to investigate the history of the sun and the planetary system. The D/H ratio on earth and in meteorites is much higher than it was in the solar nebula. This probably resulted from quasi-equilibrium chemical reactions during the accretion phase of the inner part of the planetary system. Isotopic abundances in the solar wind severely limit the extent of deep mixing in the sun. (auth)

6189 MISSING SOLAR NEUTRINOS: THEORY FOR AND AGAINST THE EXPERIMENT. Kuchowicz, B. pp 147-192 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

A general survey of the influence of various physical factors upon the solar neutrino flux is given, starting with nuclear parameters for the respective thermonuclear reactions, then atomic quantities and various physical mechanisms, up to the most speculative proposals to account for the lack of solar neutrinos in Davis' detector. Some among the suggested explanations have important consequences with respect to cosmology, to the theory of weak interactions, to the theory of solar structure and evolution, and to other areas of physics and astrophysics. Though some speculations point in favour of several consequences of the mechanisms under study, no definite solution of the solar neutrino puzzle can be proposed. (auth)

6190 ONCE MORE ON SOLAR NEUTRINOS. Kocharov, G. E. pp 193-204 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

Some possibilities of removing of the discrepancy between theoretical prediction and observation of the solar neutrinos are considered. It is shown that a sudden mixing in the solar interior being intensively discussed during last year demands a reconsidering of the He^3 hypothesis and increases its role for neutrino astrophysics of the Sun. A new possibility connected with a tiny deviation of particle distribution from Maxwellian in the high-energy tail is suggested. Such deviation may lead to the strong decreasing of high-energy neutrino fluxes. (auth)

6191 GENERATION OF HIGH ENERGY PARTICLES DURING SOLAR FLARES. Kolomeets, E. V. pp 205-210 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

On the basis of cosmic ray neutron component data it is revealed that high energy particles are generated during solar flares. The energy spectrum of the particles has a power law form with an exponent ~4. An approximation of the spectrum to the high energy region shows that the amplitude of the effect considered equals to 0.02%. (auth)

6192 ORIGIN OF SOLAR WIND PLASMA PARAMETER VARIATIONS AND ITS RELATION TO SOLAR RADIO BURSTS. Pinter, S. pp 211-239 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The presented paper points out the close relation between the velocity of coronal shock waves and the computed velocity of interplanetary shock waves. The velocity of the coronal shock waves was derived from the frequency drift of type II radio bursts and the initial velocity of the interplanetary shock waves was determined from the time of passage of the shock waves between two space probes, located at different heliocentric distances, assuming that the wave decelerated linearly upto 1 A.U. It is also shown that the radio flux at 200 MHz which is defined as the product of the "smoothed mean flux density" and the "duration" of the type IVm burst accompanying flares, correlates well with the energy flux of interplanetary post-shock waves. Also the energy of the interplanetary shock waves is proportional to the energy of the type IVm bursts. These relations of the type II and IVm bursts with the interplanetary shock waves indicate a close relation between their generating mechanisms. Drawing on the observed relations of various types of radio bursts to the variations of the solar wind, a new index of coronal activity was derived. The time variations of this new index closely follow the time variations of the parameters of the solar wind plasma, so that the new Comprehensive Solar Radio Burstiness Index (CSRBI) indicates the origin of the variations of the solar wind plasma. (auth)

6193 DYNAMICS OF THE PROCESSES IN THE SOLAR WIND. Shabanskii, V. P.; Shister, A. R. pp 241-252 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The solution of the problem of azimuth-asymmetric solar wind flow is considered on the assumption of the radial velocity of the particles emitted. The results obtained agree with the stationary sector structure and explain the character of bursts not associated with the solar flares as well as hydro- and thermodynamical parameters in the solar wind. (auth)

6194 MERIDIONAL STRUCTURE OF THE SOLAR WIND AND SOLAR COSMIC RAYS. Vladimirskii, B. M.; Levitskii, L. S. pp 253-270 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The evidences are presented of the dependence of solar wind and interplanetary magnetic field parameters on heliolatitude. The geomagnetic data, galactic cosmic ray variations, solar cosmic ray propagation, radio measurements, comet observation as well as space probes measurements are considered. It's concluded that solar wind velocity is lower (~10%) and mean number density is larger (~20%) in equatorial zone (about ± 2°) than for higher heliolatitudes. The zone of the avoidance in the propagation of solar protons was situated in heliolatitudes −5° + −2° in 1965–69. This may be caused by the presence of strong North-South asymmetry in distribution of the solar activity. (auth)

6195 SOLAR COSMIC RAYS IN AUGUST 1972. Chrakhch'yan, T. N. pp 275-298 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

Very interesting cosmic ray events associated with a series of powerful chromospheric flares in a complex active region on the Sun were detected early in August, 1972. The complex cosmic ray studies in the space, stratosphere and on the network of ground stations have permitted a great deal of information on cosmic rays in a broad energy range from several MeV to tens of GeV to be obtained. (auth)

6196 GENERATION AND PROPAGATION OF SOLAR PROTONS WITH ENERGY APPROX. 1 BeV. Gorchakov, E. V.; Timofeev, G. A.; Morozova, T. I. pp 303-310 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian).

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The present work applies methods previously developed to the analysis of 15 cosmic ray flares detected with the network of ground stations, and to the analysis of 3 flares detected from space vehicles. Conclusion of the transport path increase during intensity recovery phase is made on the assumption of constant position of the r_0-diffusion region boundary. On the other hand, the diffusion region radius, r_0, has been calculated for esch flare on the assumption of constant transport path at distances $r \leq r_0$. For all flares $r_0 = (2 \pm 0.3)$ A. U. For the flares of September 1, 1971, August 4 and 7, 1972 the energy dependence of transport path and diffusion region boundary has been examined. The transport path proved to be independent of energy. On the contrary, the diffusion region boundary varies from ~15 A.U. to ~2.5 A.U. with changing of the proton energy from 10 MeV to 1 BeV. (auth)

6197 CORRECTIONS OF THE TOTAL AREAS OF SUNSPOTS IN THE GREENWICH PHOTOHELIOGRAPHIC RESULTS FOR 1960. Kopecky, M.; Kopecka, F. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech.; 26: No. 3, 158-159(1975).

In the "Greenwich Photoheliographic Results" for 1960 the total areas of sunspots are given incorrectly for about one third of the days in the first quarter of 1960. This paper gives the correct values of the sunspot areas for these days, as well as the corresponding correct values of the monthly means, the annual mean and the means by synodic revolutions of the total areas of the sunspots. (auth)

6198 ABSOLUTE PHOTOMETRY AND THE STRUCTURE OF THE CORONA DURING THE SOLAR ECLIPSE OF JUNE 30, 1973. Rusin, V.; Rybansky, M. (Astronomical Inst. of the Czechoslovak Academy of Sciences, Lomnicky Stit). Bull. Astron. Inst. Czech.; 26: No. 3, 160-168(1975).

The geographic co-ordinates of the observation station and the eclipse contacts are given. Three photographs of the solar eclipse were used to determine the absolute values of the intensity of the white corona for all position angles. It was found that the corona was of an intermediate type with a compact wide ray above the eastern solar limb, with polar rays and an abundant structure above the western limb of the sun. The flattening pattern of the isophotes as a function of height is similar to that in the neighbourhood of minimum solar activity. The method of determining the structure of the solar corona from pictures taken without a radial filter, when short exposures are not applied, is also described. (auth)

Galaxies

Refer also to abstracts 6144–6146 and 6156.

6199 COMPUTER SIMULATIONS OF STELLAR SYSTEMS. Aarseth, S. J. (Inst. of Astronomy, Cambridge, Eng.); Lecar, M. Annu. Rev. Astron. Astrophys.; 13: 1-21(1975).

This review of numerical simulations concentrates mainly on collisional systems, that is, those whose age is greater than the time scale for significant orbital changes by encounter. Topics include the classical N-body problem, galactic clusters, globular

clusters, interacting galaxies, and violent relaxation. (120 references) (BJG)

6200 CHEMICAL COMPOSITION OF EXTRAGALACTIC GASEOUS NEBULAE. Peimbert, M. (Universidad Nacional Autonoma de Mexico, Mexico City). Annu. Rev. Astron. Astrophys.; 13: 113-131 (1975).

This review concentrates on extragalactic abundance determinations for normal HII regions, nuclear HII regions of normal galaxies, and planetary nebulae. A few particular problems associated with abundance determination methods are mentioned. A correlation is found between the degree of ionization and metallicity of giant HII regions. (100 references) (BJG)

6201 ULTRAVIOLET STUDIES OF THE INTERSTELLAR GAS. Spitzer, L. Jr.; Jenkins, E. B. (Princeton Univ., NJ). Annu. Rev. Astron. Astrophys.; 13: 133-164 (1975).

The composition and physical properties of both H I clouds and circumstellar H II regions are studied via ultraviolet line observations by Copernicus. New data on interstellar lines, observed with a grating spectrometer giving a spectral resolution of 0.05 A from 950 to 1500 A, are discussed. (200 references) (BJG)

6202 STELLAR POPULATIONS IN GALAXIES. van den Bergh, S. (Univ. of Toronto). Annu. Rev. Astron. Astrophys.; 13: 217-255 (1975).

This review examines stellar populations in the galaxy, the Magellanic Clouds, M31 and its companions, globular clusters, and dwarf spheroidal galaxies. The evolution of elliptical galaxies and the missing mass in galaxy halos and in clusters of galaxies are also discussed. (7 figures) (180 references) (BJG)

6203 HIGH-VELOCITY NEUTRAL HYDROGEN. Verschuur, G. L. (Univ. of Colorado, Boulder). Annu. Rev. Astron. Astrophys.; 13: 257-293 (1975).

This review examines neutral hydrogen emission which is often in the form of clouds or concentrations exhibiting a velocity not readily explainable by a simple model of galactic structure. Topics include observations of high-velocity clouds and models for the general high-velocity hydrogen phenomenon. (11 figures, 60 references) (BJG)

6204 RADIO OBSERVATIONS OF H II REGIONS IN THE GALACTIC CENTER. Pauls, T. A. University Park, NM; New Mexico State Univ. (1974). 93p. University Microfilms Order No. 75-10,825.

Thesis (Ph. D.).

Observations of radio recombination lines allow sources which lie along the line of sight to be distinguished from those in the galactic center. The separation is based on the radial velocities and widths of the lines. Sources along the line of sight have vertical bar V/sub LSR/vertical bar less than or equal to 10 km s^{-1} and DELTA nu approximately 20 km s^{-1}. The lines from the galactic center have radial velocities in the range +100 km s^{-1} to −150 km s^{-1}, and widths as great as 100 km s^{-1}. It is found that the galactic center sources have parallel l parallel less than 1.0^0 and parallel b parallel less than 0.2^0. The galactic center lines arise in discrete sources and an extended thermal source. The discrete HII regions are all at positive longitudes. The extended source appears to rotate as a rigid body and is neither expanding nor contracting. The extended source differs in this respect from the clouds of H_2CO and OH, which appear to form rotating and expanding rings. Within 15 arc min of Sgr A the kinematics of the ionized gas changes. Most of the lines from this region have negative velocities, but little systematic behavior is apparent. High resolution observations of CO show no correlation with the recombination lines. Sgr A West is found to emit very broad recombination lines. The lines H109 alpha, H137 beta and He109 alpha have been detected near zero velocity and have widths of about 200 km s^{-1}. These widths may be due to turbulent motions since the source is thought to be at the dynamical center of the Galaxy. The emission appears to indicate that the source is in thermal equilibrium and that the helium abundance is normal. (Diss. Abstr. Int., B)

6205 TWENTY-ONE CENTIMETER APERTURE SYNTHESIS STUDY OF THE SMALL-SCALE STRUCTURE OF THE INTERSTELLAR MEDIUM. Elliott, D. A. Los Angeles; Univ. of California (1974). 417p. University Microfilms Order No. 75-5708.

Thesis (Ph. D.).

The three-element interferometer of the National Radio Astronomy Observatory has been used to obtain 21-cm absorption maps of Cassiopeia A and Cygnus A. The technique of aperture synthesis was used to obtain complete, unambiguous maps of each source with an angular resolution of 18". Both sources were observed at two well-separated velocity ranges, enabling material in both the Perseus and local spiral arms to be seen, with velocity resolution of one-sixth km/s. The resulting maps of optical depth in the 21-cm line as a function of velocity have been used to study the physical properties of the interstellar medium at linear size scales much smaller than have been available previously. A typical line of sight in the galactic plane contains more clouds of smaller size than was previously thought. The Cas A Perseus arm data agree very well with the predictions of Roberts' Two Armed Spiral Shock model for the spiral structure of the galaxy. If the gas to dust ratio is constant, then a considerable fraction of the gas in the direction of Cas A, at all velocities, is molecular hydrogen. A picture of the interstellar medium has been presented which is in general agreement with that of Shu (1973). (Diss. Abstr. Int., B)

6206 RECOMBINATION LINES NEAR 8.9 GHz OF STRONG SOURCES IN THE SOUTHERN MILKY WAY. McGee, R. X.; Newton, L. M.; Batchelor, R. A. (CSIRO, Epping, Australia). Aust. J. Phys.; 28: 185-207 (1975).

Seventeen intense nebulae in the southern Milky Way have been surveyed for their radio recombination lines of hydrogen and helium, H 90α, He 90α, H 113β, H 129γ, and of elements heavier than helium, X 90α. The H 90α line for 30 Doradus in the Large Magellanic Cloud was also observed. Data on source size, flux density, continuum temperature, line temperature, line half-width and radial velocity are used to derive information about the sources. This information includes electron temperatures and turbulent velocities, the abundance ratio of singly ionized helium to ionized hydrogen, and the intensity ratios of β and γ lines to α lines. The lines from elements heavier than helium are discussed. (auth)

6207 DYNAMICAL MODELS OF DUST-FILLED PLANETARY NEBULAE. Ferch, R. L. Ithaca, NY; Cornell Univ. (1975). 222p. University Microfilms Order No. 75-18,128.

Thesis (Ph. D.).

Far infrared observations of planetary nebulae, and other ionized nebulae, in the ten to twenty micron wavelength region, have disclosed the existence of large infrared excesses in the spectra of these objects. The most commonly accepted explanation for this infrared radiation involves the presence of dust grains of sub-micron size, which absorb visible and ultraviolet radiation efficiently and reradiate thermally at temperatures of one to two hundred degrees Kelvin. Even relatively small amounts of dust are sufficient to absorb all of the hydrogen Lyman-alpha photons, and these are usually assumed to provide the major source of heating for the grains. In order to test this hypothesis in detail, and to study the effects of these grains on the dynamics and evolution of the nebula, a series of computer models of planetary nebulae have been constructed. These models have been carried out for nebulae of 0.15 and 0.5 solar masses, containing "normal", one-tenth, and ten times normal dust amounts. A variety of initial conditions were used, including both uniform and non-uniform initial density and velocity, and the effects of varying the stellar luminosity were also considered. The hydrodynamics of the gas were calculated using the Richtmyer-von Neumann pseudoviscosity method. In all of the models studied, the dust moved little relative to the gas. Contrary to expectations, the Lyman-alpha radiation was not the dominant source of grain heating. The expansion velocity increased with time, but considerably more slowly in the high-mass than in the low-mass case. The observed mass, calculated from the luminosity and radius, decreased strongly once complete ionization was achieved, so that real nebulae might have two or three times the mass suggested by observations, the discrepancy being accounted for by unobservable gas in the low-density tail. In general, agreement with observations is good, although significant differences exist between these models and some conclusions drawn from simpler ones. (Diss. Abstr. Int., B)

6208 FORMATION OF DISKS BY INELASTIC COLLISIONS OF GRAVITATING PARTICLES: APPLICATIONS TO THE FORMATION OF GALAXIES. Brahic, A. (Observatoire de Paris, Meudon, France). pp 173-179 of Formation and Dynamics of Galaxies. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the symposium on formation and dynamics of galaxies; Canberra, Australia (12 Aug 1973).

The numerical study of a gravitating system of colliding particles has many potential applications, for instance, the formation of flat galaxies, the formation of the solar system, and the evolution of Saturn's rings. Preliminary results are presented for the galactic case. The system tends towards a final equilibrium state and it seems that such a collision mechanism can flatten a protogalaxy. (auth)

Cosmology

Refer also to abstracts 6168 and 6634.

6209 BIANCHI TYPE I COSMOLOGICAL MODELS WITH PURE MAGNETIC FIELD. De, U. K. (Jadavpur Univ., Calcutta). Acta Phys. Pol., Ser. B; B6: No. 3, 341-346(1975).

The possible solutions for electromagnetic fields in a source-free region when the space-time admits an Abelian group of motions with three space-like generators (Bianchi Type I group). The entire set of solutions can be recovered by a simple transformation of an already known group of solutions. (auth)

6210 COSMOLOGICAL IMPLICATIONS OF ANOMALOUS REDSHIFTS: A POSSIBLE WORKING HYPOTHESIS. Jaakkola, T. (Univ. of Helsinki); Moles, M.; Vigier, J. P.; Pecker, J. C.; Yourgrau, W. Found. Phys.; 5: No. 2, 257-269(Jun 1975).

An analysis of the most recent experimental data shows that the isotropic and universal proportionality of redshift to distance, predicted for all distant objects by the expanding universe model, cannot be regarded as an established fact at the present stage of experimental knowledge. An interpretation of the conflicting data is given in terms of interactions between nonzero-mass photons and light scalar bosons. This leads to a new, static, Einstein-type hierarchical model of the universe, where the cosmological redshift results essentially from a tired-light effect. (auth)

6211 LINEAR-MOMENTUM CHANGES IN ASTROPHYSICAL PROCESSES DUE TO NEUTRINO EMISSION. Tennakone, K. (Univ. of Sri Lanka, Nugegoda, Ceylon). Lett. Nuovo Cim.; 13: No. 14, 555-556(2 Aug 1975).

It is pointed out that nonconservation of parity in weak interactions can have an observable macroscopic effect in changing the linear momentum of an astrophysical system emitting neutrinos in the presence of a strong magnetic field. (GHT)

6212 ARROW OF TIME. Layzer, D. Sci. Am.; 233: No. 6, 56-69(Dec 1975).

A model of the universe which resolves the apparent contradiction between the historical and the thermodynamic arrows of time is presented. Both arrows are reconciled with the almost time-symmetric character of physical laws at the microscopic level. The theory implies that the universe is unfolding in time but not unraveling. (BJG)

6213 CLASS OF COSMOLOGICAL MODELS WITH TORSION AND SPIN. Tafel, J. (Univ., Warsaw). Acta Phys. Pol., Ser. B; B6: No. 4, 537-554(1975).

Homogeneous models of the universe filled with a spinning fluid are studied in the framework of the Einstein-Cartan theory of gravitation. It is assumed that the models admit a group of motions simply transitive on three-surfaces orthogonal to the world lines of the substratum. For certain group types, the field equations are partially integrated. The models of the Bianchi types I, VII_0, V are shown to be nonsingular, provided the influence of spin exceeds that of shear, and an equation of state satisfies some physically reasonable conditions. (auth)

Planetary Phenomena

6214 INFLUENCE OF THE INTERPLANETARY SECTOR STRUCTURE ON THE GEOMAGNETIC ACTIVITY AND RADIO PROPAGATION QUALITY. Moldovanu, A. (Centrul de Cercetari de Fizica si Tehnica, Iasi). pp 426-433 of International Symposium on Solar-Terrestrial Physics. Vol. 2. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

The influence of sector structure on several aspects of geomagnetic activity and on radio propagation quality in the short-wave range are pointed out. Results indicate that the effects of the sector boundaries are important and general with regard to all aspects of geomagnetic activity. Most geomagnetic and associated telecommunications disturbances can be accounted for by corotating distortions in the solar wind, which are in turn connected with sector structure. (IAA)

6215 ENERGETIC PARTICLE FLUXES AND SPECTRA IN THE JOVIAN MAGNETOSPHERE. Baker, D. N. Iowa City, IA; Univ. of Iowa (1974). 219p. University Microfilms Order No. 75-13,722.

Thesis (Ph. D.).

The University of Iowa Pioneer 10 instrument is described and summaries of detector calibrations, data analysis techniques, and pertinent theories of the Jovian magnetosphere are presented. The in situ observations made with the University of Iowa energetic particle detectors in the Jovian magnetosphere reveal a relatively thin, outer magnetospheric region (called the magnetodisc) extending to a radial distance of over 100 R/sub J/ (Jovian radii) and a central magnetosphere of stably trapped particles inside of 15-20 R/sub J/. Particle species identification analysis demonstrates that observed counting rates are due primarily to electrons, E/sub e/ greater than 0.06 million electron volts (MeV). (Diss. Abstr. Int., B)

6216 KRYPTON AND XENON IN LUNAR AND TERRESTRIAL SAMPLES. Drozd, R. J. Seattle; Washington Univ. (1974). 366p. University Microfilms Order No. 75-6590.

Thesis (Ph. D.).

Results of heavy rare gas measurements on lunar and terrestrial samples made at the Washington University spectrometer facility are reported. Lunar breccias and basalts returned by the Apollo 14, 15, and 16 missions were studied. Terrestrial uranium ores from Rabbit Lake, Saskatchewan, Canada, and Oklo, Republic of Gabon, were examined for their fission rare gas content. Analysis of lunar samples 14313 and 14318 confirms the results found on 14301 that fission xenon from the decay of ^{244}Pu is present in lunar samples. A spectral decomposition was made for 14318 and a fission spectrum identical to that obtained from man-made ^{244}Pu was derived. 14301 was found to have a ^{129}Xe excess most likely due to the decay of 17 my ^{129}I. These xenon components in the gas-rich Apollo 14 breccias are not due to in situ decay; they appear to have been formed in the lunar interior and subsequently incorporated into the surfaces of grains from which these breccias formed. A few gas-poor lunar breccias have been found to have fission xenon excess by a method which minimizes the effects of spallation gas. Xenon and krypton isotopic studies on two samples from the Oklo mine confirm that it was the site of a natural spontaneous chain reaction. By a method insensitive to xenon gas loss an integrated neutron fluence of approximately 4×10^{20} n/cm^2 for the Oklo samples can be calculated. A probable time limit for the active period at Oklo of between 14,000 and 70,000 years is obtained. Rabbit Lake samples show no evidence for a self-supporting chain reaction. (Diss. Abstr. Int., B)

6217 DYNAMICAL STUDIES OF SATELLITE ORIGIN. Harris, A. W. Los Angeles; Univ. of California (1975). 130p. University Microfilms Order No. 75-16,784.

Thesis (Ph. D.).

Based on the work of E. L. Ruskol (Sov. Astron. AJ 4, 657, 1960) in which lunar formation by accretion in earth orbit is suggested, models of growth of a planet-satellite pair were formulated. The orbit of a growing satellite is affected by tidal friction, which generally causes outward evolution, and inward spiraling caused by the "drag" effect of the accretion process itself. The principal results of the study are: the balance between energy brought into a planetary ring by bombardment by planetesimals and energy loss by internal collisions will sustain a proto-satellite ring in a gravitationally stable configuration until its mass reaches approximately 10^{-4} of the planet's mass. For values of Q expected for terrestrial planets, a newly coagulated satellite embryo would be held at approximately 10 planet radii by the opposing forces of tidal friction and accretion drag. Such an embryo, formed early in the planet's growth at approximately 10^{-4} of the planet's mass, could become relatively much more massive in the course of the remaining accretion. In the absence of tidal friction, a ring or satellite embryo can only gain a factor of approximately 3 in mass by accretion before spiraling into the planet. (Diss. Abstr. Int., B)

PHYSICS (ATMOSPHERIC)

6218 SUPERSONIC NEUTRAL WINDS IN AN OUTER ATMOSPHERE. III. A Two-Dimensional Model. Gilbert, N. E. (La Trobe Univ., Bundoora, Australia). Aust. J. Phys.; 28: 85-99(1975).

A steady two-dimensional model that represents the part of a convection cell where the neutral gas constituent is rising and becoming supersonic is presented for both isothermal and variable temperature conditions in an intensely heated region of the outer atmosphere of a planet or star. The streamlines and orthogonal curves are represented by a system of confocal hyperbolae and ellipses respectively. The nozzle throat is achieved principally by the physical contraction and subsequent expansion of the gas rather than by a variation in the temperature or in the gravitational force component along the streamline. Regions in which supersonic speeds may be achieved are investigated by making suitable approximations both when the streamline is nearly vertical and when it approaches its asymptote. The characteristic patterns for the velocity and heating contours are shown, and the effects which parameters have in modifying these patterns are discussed. (auth)

Auroral and Ionospheric Phenomena

Refer also to abstracts 6139 and 6248.

6219 (NASA-SP--361, pp 125-129) SOLAR AND CORPUSCULAR HEATING OF THE UPPER ATMOSPHERE. Chandra, S. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The usefulness of argon in deriving thermospheric temperature is discussed. Data from the AEROS NATE experiment is presented. (BJG)

6220 (NASA-SP--361, pp 135-138) SEASONAL VARIATIONS OF UPPER ATMOSPHERE COMPOSITION. Reber, C.A. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The effect of the seasonal variation, due to the tilt of the earth's axis, on the weather of the upper atmosphere is discussed. Data obtained by the OGO-6 mass spectrometer are presented. (BJG)

6221 (UCRL-77115) PROPERTIES OF AURORAL-LINE INDUCED TRANSITIONS. Murray, J. R.; Powell, H. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Aug 1975. 7p. (CONF-750914-5). Dep. NTIS $4.00.

From 2nd summer colloquium on electronic transition lasers; Woods Hole, Massachusetts, USA (17 Sep 1975).

The radiation induced near the $O(^1S)$–$O(^1D)$ auroral-line of atomic oxygen by collisions with rare gas atoms has been studied. Emission from both bound, quasi-molecular states and from free atoms perturbed in collisions is observed. Experimental measurements of kinetic rates and their temperature dependences will be presented. (auth)

6222 SILICON IONS BELOW 100 km: A CASE FOR SiO_2^+. Goldberg, R. A. (Goddard Space Flight Center, Greenbelt, MD). Radio Sci.; 10: 329-334(Mar 1975).

An investigation regarding the occurrence of Si ions is conducted, taking into account an unusual metal ion structure observed during a meteor shower event. Loss processes involving silicon oxides are considered in connection with a study of the reasons for the unique Si(+) distribution found. It is suggested that below 100 km Si(+) is rapidly depleted by two- and three-body reactions with molecular oxygen, forming SiO_2^+ which then recombines. (IAA)

6223 OVERALL RESULTS FROM THE ARCAD EXPERIMENT ABOARD THE SATELLITE AUREOLE. Cambou, F. (Univ., Toulouse); Galerin, Yu. I. pp 396-411 of International Symposium on Solar-Terrestrial Physics. Vol. 2. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

Aureole I (apogee: 2500 km, perigee: 400 km, inclination: 74 deg) was intended for studying auroral and polar-cap phenomena during magnetically quiet periods. Data obtained in the energy range from 0.3 to 30 keV on the auroral protons and the polar cusp, and on the intensity fluctuations of electrons (29 to 54 keV) and protons (150 to 240 keV) are diagrammed and discussed. A plot of the characteristics of 0.4 to 30 keV electrons and protons recorded during a satellite passage across the daytime auroral zone and the polar cusp shows that, unexpectedly, the polar-cusp's highest intensity region appears to lie close to magnetic midday. (IAA)

6224 GENERAL FEATURES OF AURORAL PARTICLES IN DIFFERENT MAGNETIC SECTORS AS MEASURED BY ROCKETS. Reme, H.; Bosqued, J. M. (Univ., Toulouse). pp 414-424 of International Symposium on Solar-Terrestrial Physics. Vol. 2. Sao Jose Dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

The data obtained on electron and proton precipitation in auroral zones using several sounding rockets in different magnetic sectors, during substorms, give the following general results. The precipitation mechanisms are strongly energy dependent. Above about 5 keV, gyroresonant interactions with VLF-ULF waves account for the angular distributions observed and the diffusion coefficients calculated. Below about 5 keV, aligned electric fields and bounce resonance interactions, have an appreciable effect on the precipitation. Aligned currents coupling the ionosphere with the magnetosphere are detected indirectly, circulating either upward or downward in the ionosphere, depending on magnetic time. (auth)

6225 LARGE-SCALE FLUCTUATIONS OF IONOSPHERIC ABSORPTION. Ebel, A.; Baetz, W. (Univ., Cologne). pp 6-12 of International Symposium on Solar-Terrestrial Physics. Vol. 3. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

Large-scale fluctuations of ionospheric absorption are investigated on a global basis by means of spectral analysis. It points out that variations with periods larger than about 15 days may be correlated over distances of more than 140 degrees latitude. Such correlations can easily be explained by the dependence of the absorption on the ionization processes in the lower ionosphere. On the other hand, there exist significant fluctuations in the spectral range around 1/40 per day which cannot be explained in these terms. They can best be observed at middle latitudes during summer in periods of low solar activity. It is attempted to construct a few examples of lines with enhanced or reduced absorption from such fluctuations using a network of stations between 4 W and 85 E. These lines may be interpreted as indications of planetary waves. It follows from the global analysis of absorption that a large amount of the total variance is contained in the frequency range from about 1/90 to 1/3 per day, which is of special interest for a meteorological concept of the lower thermosphere. (auth)

6226 NATURE OF STRATOSPHERIC POSITIVE IONS. Krankowsky, D.; Arnold, F. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 21-29 of International Symposium on Solar-Terrestrial Physics. Vol. 3. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

A mass analysis of positive ions above 35 km revealed the presence of masses 37, 55, 60 ± 2, and 80 ± 2. The first two are identified as the proton hydrates H(+)(H2O)2 and H(+)(H2O)3 whereas it is difficult to interpret the other masses due to the great number of ions which can be attributed to these mass numbers. The observed electric field fragmentation of these ions during sampling the stratospheric plasma indicates that they are cluster ions. An attempt to interpret the masses 60 ± 2 and 80 ± 2 is made, and an ion reaction scheme is discussed. (auth)

6227 NEW CONCEPT FOR THE D-REGION ION CHEMISTRY AS INFERRED FROM A MASS SPECTROMETER MEASUREMENT. Arnold, F.; Krankowsky, D. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 30-50 of International Symposium on Solar-Terrestrial Physics. Vol. 3. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

The detection of cluster ions of the type A(+)-N2, A(+)-O2, A(+)-CO2, and A(+)-H2O (A(+) being NO(+), O2(+), NO2(+), and H2O2(+), or a cluster ion) suggests a fast cluster ion formation via associations of major constituents N2 and O2 followed by switching with CO2 and H2O. Due to the low stability of the intermediate ions A(+)-N2 and A(+)-O2 at D-region temperatures, this reaction scheme makes the temperature a very important parameter in controlling the ion composition and thereby the plasma density. (auth)

6228 POSITIVE IONS COMPOSITION VARIATIONS IN THE D-REGION. Danilov, A. D.; Simonov, A. G. (Hydrometeorological Brazil , Moscow). pp 51-68 of International Symposium on Solar-Terrestrial Physics. Vol. 3. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

The analysis of the published mass-spectrometer data on the positive ions composition of the D-region shows, that the ratio of clustered ions concentration to "normal" ions concentration is strictly dependent on conditions. The dependence on ionization rate and electron concentration is found. This behavior of the concentration ratio of clustered to normal ions is considered in terms of a new scheme of ionization-recombination transformations in the upper D-region. Conclusions about the variations of the effectiveness of two channels responsible for clusters formation are drawn. (auth)

6229 D-REGION AND THE ORBITAL PLANE OF COMET HALLEY. Gough, M. P. (Mackenzie Univ., Sao Paulo, Brazil). pp 69-74 of International Symposium on Solar-Terrestrial physics. Vol. 3. Sao Jose dos Campos, Brazil; Instituto de Pesquisas Espaciais (1974).

From proceedings of international symposium on solar-terrestrial physics; Sao Paulo, Brazil (17 Jun 1974).

The photo-ionization of sodium atoms can be an important source in the upper D-region during twilight. Sodium photo-ionization accounts for, on the average, between 18 per cent and 64 per cent of the total twilight ionization at 90 km depending on the season. Increased atmospheric sodium emission was observed by Visconti and Fiocco (1973) to occur after the earth crossed through the dust in the orbit of Comet Halley in May 1971 and May 1972. Here it is shown that corresponding electron density changes occurred in the twilight D-region at the times of the orbital crossings in May 1971 and 1973, confirming the importance of sodium photo-ionization at twilight. (auth)

6230 MOMENT METHODS FOR SOLVING ASYMMETRICALLY DRIVEN rf PROBES IN THE COLLISIONAL IONOSPHERIC MAGNETOPLASMA. Hwang, H. S. Logan, UT; Utah State Univ. (1974). 179p. University Microfilms Order No. 75-14,443.

Thesis (Ph. D.).

The moment method is discussed, and the application of this method for solving asymmetrically driven RF probes in the collisional and warm ionospheric magnetoplasma is presented. The first three velocity moments of the Boltzmann transport equations are used for the description of the plasma. No interrelation between the electromagnetic mode and the plasma mode is assumed. The effects of these two modes on the antenna impedance are compared and it is shown that the electromagnetic effect is negligible with respect to the plasma effect under certain conditions. The absorptive boundary condition is considered so that the ion sheath may be treated as collapsed. Typical monopole, symmetrical dipole and asymmetrical dipole antennas are considered and many impedance curves are presented. Since the antenna impedance curves are related to all the plasma parameters, the methods of the prediction of plasma parameters from the measured antenna impedances are mentioned. Further research is proposed to eliminate the quasi-static restriction. (Diss. Abstr. Int., B)

6231 LONG DELAYED RADIO ECHOES. Sears, D. M. Stanford, CA; Stanford Univ. (1975). 242p. University Microfilms Order No. 75-13,597.

Thesis (Ph. D.).

This thesis describes an experimental program carried out at Stanford over a five-year period. The experiment involved transmitting a radio signal, and tape-recording the output of a receiver gang-tuned with the transmitter for the following 30 s interval. The tapes were later audited for possible LDE. Although none of the possible LDE received reproduces exactly the transmitted signal, many exhibit features that seem unlikely to have been generated except by an LDE mechanism. A mechanism for producing LDE has been studied which involves signal propagation in an electron plasma wave mode at very low group velocity. Modifications to the simplified theory leading to prediction of longer delays are discussed. (Diss. Abstr. Int., B)

6232 CLOUD-CHAMBER SEARCH FOR MULTIPLE-CORES AND HIGH TRANSVERSE-MOMENTA IN COSMIC RAY AIR SHOWERS. Keller, O. A. Ann Arbor, MI; Univ. of Michigan (1974). 163p. University Microfilms Order No. 75-10,199.

Thesis (Ph. D.).

In this experiment, the Leeds 2.87 m^2 cloud-chamber is located at the center of a 7.2 m x 7.2 m array of ten scintillators that trigger the chamber on showers of approximately equal to 10^5 particles whose cores fall within approximately equal to 5 m of the center of the array. Model calculations indicate that even if every nuclearactive collision in an air shower creates a product hadron with high transverse momentum - and thus a sub-core, only one such sub-core would be detected per month by the Leeds apparatus. Visual examination of the cloud-chamber photographs of the 3285 events recorded during six months' operation reveals 89 shower-core candidates. For most of these candidates, the separation between the shower-axis located by the scintillator data and the axis seen in the cloud-chamber obeys a two-dimensional Gaussian distribution. For 7 events, however, the separation is greater than or equal to 4 sigma, and these candidates are either sub-cores or products of local interactions. One of these 7 contains almost 90 charged particles within a radius of 0.2 m and may be a genuine sub-core indicating a transverse momentum of 15 GeV/c. Observing a single sub-core in the cloud-chamber implies that about $\frac{1}{3}$ of the 10^5-particle showers that trigger the chamber have sub-cores. Model calculations show that interactions of shower hadrons in the roof should cause about 0.2 dense regions of the size observed in the cloud-chamber. Model calculations show that the roofing above the Kiel detectors is probably not sufficient to develop all of the dense regions that they observe. (Diss. Abstr. Int., B)

6233 NEUTRON AND PROTON MEASUREMENTS OF OSO-6 NEAR THE SOUTH ATLANTIC RADIATION ANOMALY. Cooper, P. J. Albuquerque, NM; Univ. of New Mexico (1974). 115p. University Microfilms Order No. 75-6963.

Thesis (Ph. D.).

The University of New Mexico High-Energy Neutron Experiment flown aboard NASA Satellite OSO-6 in 1969 was designed and built to study neutrons at an altitude of approximately 500 km, above the earth's dense atmosphere. The detector was a proton recoil telescope with directional discrimination and was sensitive to protons as well as neutrons. Neutron data from August, 1969 to January, 1971 was analyzed in the energy range 40-120 MeV. Proton data in the energy range 60-170 MeV obtained during October and November of 1969 was also analyzed. Analysis was limited to the region of space known as the South Atlantic Radiation anomaly. This investigation was carried out to study source and loss mechanisms of the Van Allen radiation belts. The omnidirectional proton flux as a function of B and L at approximately 500 km altitude in the anomaly (latitude limit -33^0) was presented. Results in the 200-400 km minimum mirroring altitude range gave good agreement with previous effective atmospheric loss computations indicating that coulomb interactions are the prime loss mechanism for inner belt protons. Results in the 400-500 km minimum mirroring altitude range indicated possible problems with the high altitude constituents of the model atmospheres considered here. The east-west ratios of the neutrons near the anomaly indicated that more neutrons are being generated in the anomaly than elsewhere. These additional neutrons are most likely being produced by high-energy trapped protons colliding with the atmosphere in the anomaly. (Diss. Abstr. Int., B)

6234 COSMIC RAY MUON SPECTRUM AND CHARGE RATIO. Abdel-Monem, M. S. E. D. Houston, TX; Univ. of Houston (1974). 242p. University Microfilms Order No. 75-10,993.

Thesis (Ph. D.).

The absolute cosmic ray muon spectrum and charge ratio for zenith angles 0^0, 65^0 and 80^0 has been investigated both theoretically and experimentally. Theoretically, models of high energy interactions are used to calculate the spectrum of cosmic ray muons at sea level. The charge ratio is calculated as well. A comparison is made between the measured spectrum and that predicted on the basis of the four theoretical models. The data have been fitted using the chi^2 technique to the phenomenological model given by Fyodorov et al., (1973). The parameters from the present experiment are compared with those of other workers. It is concluded that: The measured muon differential intensities agree with the scaling model for energies less than 100 GeV and with the CKP model for energies greater than 200 GeV. The measured differential intensity of the present work agrees with scaling. The measured muon spectrum of the present work is in reasonable agree-

ment with earlier AMH results and previous magnetic spectrometer data. The accuracy of the present work is better than that of the earlier results. The predicted muon charge ratio including the geomagnetic effects agrees with the measured charge ratio of the present work. (Diss. Abstr. Int., B)

6235 IONOSPHERIC GRAVITY WAVE EFFECTS ON THE ANGLE OF ARRIVAL OF SOLAR METRIC RADIO WAVES. Colpitts, C. W. London, Ont.; Univ. of Western Ontario (1974). vp. National Library of Canada, Ottawa.

Thesis (Ph. D.).

Angle of arrival measurements of solar radio waves frequently exhibit large-scale fluctuations, sometimes attributed to motions in the sun's atmosphere. Solar interferometer observations were made at 50 and 150 MHz as well as satellite beacon angle of arrival measurements at the higher frequency. It is shown that a great many large-scale variations are caused by gravity wave induced travelling disturbances in the terrestrial ionosphere. Techniques of spectral analysis and a three-dimensional treatment of the focussing of radio waves by large ionospheric irregularities are used in the interpretation of the results. The use of the sun as a radio beacon to study the ionosphere is also discussed. (Diss. Abstr. Int., B)

6236 SOLAR COSMIC RAYS AND PARTICLE FLUXES PENETRATION INTO THE IONOSPHERE. Velinov, P.; Nestorov, G. pp 389-405 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The problem of influence of solar cosmic rays on the ionosphere during the solar flares is discussed. Effects of penetration of solar cosmic rays and particle fluxes into the ionosphere has been considered. (auth)

6237 TOTAL ELECTRON CONTENT OF THE IONOSPHERE OVER THE MAGNETIC EQUATOR. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India); Iyer, K. N.; Bhattacharyya, J. C. Curr. Sci. (India); 44: No. 15, 531-533 (5 Aug 1975).

Total electron content of the ionosphere (N_t) at Kodaikanal (dip 3.4° N, Geogr. longitude 77°E) is measured using the faraday rotation of the 40 MHz signals from the low orbiting beacon satellites explorer 22 and 27 during the period November 1964 to December 1966. The diurnal variation of N_t is compared with the diurnal variation of the maximum electron density in the F region, N_m. The noon bite-out which is present in N_m is not seen in N_t. The latitudinal variation of N_t, obtained by combining the observations at Kodaikanal and Ahmedabad indicate the presence of the equatorial anomaly in N_t with peak around 15° dip latitude. The results are discussed in relation to the observations at other equatorial stations in African and American sectors. The latitudinal anomaly in neutral density is suggested to play a role in the latitudinal variation of N_t. (auth)

6238 NATURE OF D-REGION SCATTERING OF VERTICAL INCIDENCE RADIO WAVES. I. Generalized Statistical Theory of Diversity Effects Between Spaced Receiving Antennas. Lindner, B. C. (Univ. of Adelaide). Aust. J. Phys.; 28: 163-170(1975).

A theoretical basis for studying the nature of ionospherically reflected radio waves is described. The expected statistical properties of the amplitude and phase variations of the radio wave ground pattern sampled at a pair of spaced receiving antennas are derived for general correlation conditions, assuming different models of the angular spectrum of reflected radio waves. The results provide a basis for experimental measurements of the angular spread and coherence ratio of the angular spectrum of reflected waves. (auth)

6239 NATURE OF D-REGION SCATTERING OF VERTICAL INCIDENCE RADIO WAVES. II. Experimental Observations Using Spaced Antenna Reception. Lindner, B. C. (Univ. of Adelaide). Aust. J. Phys.; 28: 171-184(1975).

Statistical properties of the ground diffraction pattern formed by ionospherically reflected radio waves are used to examine models of the angular spectra of reflections from the ionospheric D-region. In the daytime two distinct height regions characterized by differing reflection mechanisms are identified within the D-region. Below 85 km the angular spectrum of reflected waves frequently contains coherent components, whereas a spectrum of incoherent or randomly phased components is characteristic of reflections from the region above 85 km. There is evidence which suggests the presence on many occasions of isolated moving reflectors in the reflecting "ionospheric screen." Both the mean angular spread and the fading speed of waves partially reflected from the D-region show an increase with increasing height of reflection. (auth)

6240 CORRELATIONS OF IONOSPHERIC ELECTRIC FIELDS AND ENERGETIC PARTICLE PRECIPITATION. Whalen, B. A.; Verschell, H. J.; McDiarmid, I. B. (National Research Council of Canada, Ottawa, Canada). 80: No. 16, 2137-2145(1 Jun 1975).

Direct measurements of the thermal ionospheric ion distribution function made from two sounding rockets launched into the expansive phase of an auroral substorm are discussed. Ion flows perpendicular (convective) and parallel to the geomagnetic field lines are derived from these observations at altitudes from 200 to 840 km. Equivalent convective electric fields were observed to vary between a few tens of millivolts per meter to over 150 mV/m and are shown to be highly correlated with energetic electron precipitation. High-velocity (up to 2 km/s) parallel ion flows were observed at various times and also found to be correlated with auroral electron precipitation. A correlation analysis of perpendicular (or equivalent electric fields E/sub perpendicular/) and parallel ion flow velocities with energetic electron intensities I at various energies is presented. The form of the E/sub perpendicular/ versus the logarithm of I relationship is shown to be approximately linear over most of the observed E/sub perpendicular/ range. Ionospheric "line-tying" models are presented and compared with the measured E/sub perpendicular/ versus I relationship. The model is found to be most consistent with observations when magnetospheric forces are assumed to be independent of the instantaneous values of E/sub perpendicular/ and I rather than viscouslike. No evidence was found to suggest that decoupling of magnetospheric and ionospheric convection through parallel electric fields produced the observed anticorrelation of E/sub perpendicular/ and I. (auth)

6241 DETERMINATION OF F REGION HEIGHT AND PEAK ELECTRON DENSITY AT NIGHT USING AIRGLOW EMISSIONS FROM ATOMIC OXYGEN. Tinsley, B. A.; Bittencourt, J. A. (Univ. of Texas, Dallas). 80: No. 16, 2333-2337(1 Jun 1975).

Measurements of the vertical column emission rates of atomic oxygen emissions arising from radiative recombination, ion-ion recombination, and dissociative recombination in the nighttime F region are sufficient to remotely sense the F layer height and peak plasma density. For example, measurements can be made of O I 1356 A and [O I] 6300 A, with vertical column emission rates J_{1356} and J_{6300}. To a very good approximation the peak electron density is proportional to (J_{1356})/sup 1/2/, and second-order dependence on height and exospheric temperature is very small. To a good approximation the ratio (J_{1356})/sup 1/2//J_{6300} is a single-valued function of the layer height. (auth)

6242 ATMOSPHERIC HEATING BY SOLAR EUV RADIATION. Stolarski, R. S. (Univ. of Michigan, Ann Arbor); Hays, P. B.; Roble, R. G. 80: No. 16, 2266-2276(1 Jun 1975).

The diurnal variation of the neutral gas heating efficiency due to photo-ionization processes lambda less than or equal to 1025 A is calculated by using a diurnal model of the mid-latitude ionospheric F region. The absorbed solar energy is split between photoelectrons and ion pair production that becomes stored chemical energy. This energy is then transferred to the neutral gas through elastic and inelastic collisions of photoelectrons with the neutrals and through heating associated with exothermic ion-molecule chemical reactions. In addition, neutral gas heating also occurs by elastic and inelastic collisions between the electrons, ions, and neutrals due to thermal conduction of heat in the electron gas from the magnetosphere. Neutral heating by collisional processes between electrons, ions, and neutrals is dominant above 300 km. Between 170 and 300 km, photoelectrons and chemical reactions are the major heat sources. Below 170 km the neutral heating is primarily due to the absorption of the Schumann-Runge continuum. The calculations also show that neutral gas heating due to absorbed airglow emissions is generally negligible for dayglow processes. The neutral gas heating efficiency due to EUV solar heating (lambda less than or equal to 1025 A) below 400 km lies between 30 and 35 percent. The calculated electron gas heating efficiency, below 250 km, where photoelectron heating predominates, is roughly 5 percent, and the ion heating efficiency is about 2 percent with respect to the absorbed EUV solar energy. (auth)

Magnetospheric Phenomena

Refer also to abstracts 5194, 6183, 6184, and 6224.

6243 (N-75-15455) INJECTION OF A PLASMA CLOUD IN A TRANSVERSE MAGNETIC FIELD. Rosinskii, S. E.; Rukhlin,

V. G.; Savchenko, M. A. (AN SSSR, Moscow). Jan 1975. Translated from 1-54 of Inzhektsiya Plazmennogo Sgustka v Poperechnom Magnitnom Pole. (NASA-TT-F-16110; PR-157). 48p. NTIS $3.75.

A qualitative description is given of the evolution of a dense plasma cloud, which is injected into the magnetosphere perpendicular to the magnetic field force lines. Characteristic times are evaluated for the free expansion and diffusion of the magnetic field into the cloud. Hydromagnetic instability questions are considered for the cloud surface. This instability is related to the surface curvature and the passage of the cloud around the magnetosphere plasma at the initial stage of magnetic field diffusion into the cloud. The effects of pressure anisotropy, which is caused by the passage of the cloud along the magnetic field force lines, are studied on the drift, and current instabilities are studied in the case of subsequent spreading of the cloud along the magnetic field. New instability modes are found which significantly affect the pressure anisotropy in an inhomogeneous plasma, or in the presence of a flux of particles in the plasma. (auth)

6244 (NASA-SP-361, pp 108-111) MODELS OF THE MAGNETOSPHERIC ELECTRIC FIELD. Stern, D. P. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

Model representations of the magnetospheric electric field and the application of such models to explain observations are discussed. (BJG)

6245 (NASA-SP-361, pp 112-115) ELECTRIC FIELDS IN THE MIDNIGHT SECTOR OF THE MAGNETOSPHERE. Maynard, N. C. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The magnetospheric electric field is an ordering function which is present in both quiet times and during substorm activity. The Harang discontinuity or fault line in the electric field defines the location in the ionosphere and magnetosphere from which events can be triggered to create various phenomena. (BJG)

6246 (NASA-SP-361, pp 116-119) MAGNETOSPHERIC RING CURRENTS. Hoffman, R. A. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

A theoretical model of the ring current problem is discussed. The theory suggests that the convective system of the magnetosphere could supply and energize protons for the magnetic storm-time ring current, which produces the main phase magnetic variation during magnetic storms. Experimental measurements of the characteristics of the storm-time ring current protons substantiate the theory. (BJG)

6247 (NASA-SP--361, pp 120-124) DYNAMICS OF THE THERMAL PLASMA IN THE MAGNETOSPHERE. Chen, A. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The connection between magnetospheric convection and thermal plasma dynamics is discussed. A model is presented in which the magnetic field is assumed to be dipolar and the field lines beyond 10 earth radii are assumed to be open to the magnetopause. (BJG)

6248 (NASA-SP--361, pp 130-134) MAGNETIC-STORM-RELATED PLANETARY WAVES. Mayr, H. 1975.

From symposium of significant accomplishments in science and technology; Greenbelt, Maryland, USA (18 Dec 1973).

In significant accomplishments in science and technology. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center).

The semiannual variations of planetary waves is, by comparison with the annual variations, much too large to be simply accounted for by solar radiation. Circumstantial evidence suggests that the magnetosphere is a source for semiannual oscillations in the mesosphere. (BJG)

6249 HYDRODYNAMIC PLASMA FLOW IN A STRONG MAGNETIC FIELD. Somov, B. V.; Syrovatskii, S. I. pp 14-72 of Gidrodinamicheskie Techeniia Plazmy v Sil'nom Magnitnom Pole. Basov, N. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian)

A series of problems in plasma dynamics particularly relevant to space physics are examined using an approximation of strong magnetic field. Problems of steady flow in the absence of zero points in the magnetic field are examined in the case of a magnetic dipole field that increases with time, and the results are applied to solar phenomena such as formation of eruptions, condensations, and spicules. Problems of flow leading to the formation of current sheets in the presence of singular zero points are studied for a two-dimensional magnetic dipole. The results are applied to the formation of the geomagnetic tail and the solar coronal rays. Through numerical integration, the particle velocity and density distributions in the vicinity of the current sheet are found. The calculations prove that the density of the plasma diminishes with time in the vicinity of a current sheet. (IAA)

6250 REMARKS ON THE GROWTH PHASE OF SUBSTORMS. Rossberg, L. (Max-Planck-Institut fuer Aeronomie, Lindau Ueber Northeim, Ger.). pp 367-376 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

A pre-bay poleward expansion of 30-plus keV electron intensities near midnight is shown to be coincident with the maximum phase of a plasma sheet expansion in the predawn sector of the Vela orbit. A study of simultaneous particle observations by ATS 1 and 5, and of perturbations of the horizontal component of the magnetic field on ground in the auroral zone, shows that one can arrive at two different conclusions about the relevant substorm phase. Based on the results of a multisatellite study it is suggested to supplement the search for growth phase phenomena by a more general consideration of the varying modes of energy release into the auroral zone. (auth)

6251 POLAR CAP OPTICAL AURORA SEEN FROM ISIS-2. Anger, C. D. (Univ. of Calgary, Alberta); Sawchuk, W.; Shepherd, G. G. pp 357-366 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

The variety of different auroral features observed inside the auroral oval with two photometers on the ISIS-2 satellite are described. The instruments scanned the earth from horizon to horizon at wavelengths of 3914, 5577, and 6300 A, providing a complete mapping of a large part of the auroral zone during one favorable pass. Four categories of polar cap auroras are considered: the midnight poleward-expanded aurora, the sun-aligned 6300 arcs, the sun-aligned 5577 arcs, and diffuse and discrete auroras in the polar cap associated with a major magnetic storm. Discussion of these phenomena centers on their common formative process, possibly some form of discontinuity in magnetospheric convection. (IAA)

6252 DYNAMICS OF AURORAL ABSORPTION. Hargreaves, J. K. (Univ. of Lancaster, Eng.). pp 349-356 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

Current simplified theories of auroral absorption movement are criticized. It is shown that satisfactory explanations must account for not only the average pattern but also variations about the average. The dynamics within the substorm are not necessarily related to the behavior of the substorm as a whole. Wide-baseline studies of absorption peaks are observationally biased, because the faster peaks are selected at the expense of the slower ones. The eastward median velocity of absorption peaks is nearer to 1 deg/min, as determined from short-baseline studies, than to 3 deg/min as is usually quoted. (IAA)

6253 CRITICAL PROBLEMS IN ESTABLISHING THE MORPHOLOGY OF SUBSTORMS IN SPACE. McPherron, R. L. (Univ. of California, Los Angeles). pp 335-347 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

A phenomenological model of the magnetospheric substorm has been developed which divides the substorm into three phases: a growth phase, an expansion phase, and a recovery phase. Current research is reviewed in the light of criticism of this model. The most important inadequacies of the model concern the fact that the tail lobe and the plasma sheet do not always react as

single entities as previously supposed. Further research is needed on the problems of substorm variability, errors in onset time, the number of distinct spatial regions, and the dependence of magnetic activity on past history. (IAA)

6254 AURORAL ELECTRONS OBSERVED USING A MOTHER–DAUGHTER ROCKET. Courtier, G. M.; Smith, M. J.; Bryant, D. A. (Science Research Council, Slough, Eng.). pp 207-211 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

Electron intensity measurements obtained from the Skylark rocket launched from Kiruna in March 1972, which resolved spatial and temporal intensity variations of precipitating auroral electrons, are presented. Intensity changes occurred as pulses which were ascertained to be temporal rather than spatial phenomena. Disturbance source distances were determined and showed a systematic change with time. Pitch angle scattering is proposed as a cause of the changes in intensity of the precipitated electrons. A suggested explanation of the varying source distance is that the position of the weakest field changes. (IAA)

6255 MOTHER–DAUGHTER ROCKET STUDIES OF LOW ENERGY ELECTRONS NEAR AURORAL ARCS. Moestue, H.; Maehlum, B. N. (Forsvarets Forskningsinstitutt, Kjeller, Norway). pp 199-205 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

Attention is given to pitch angle and energy distribution variations across auroral arcs. A region of soft, field-aligned electron fluxes is observed equatorward and poleward of the auroral arcs. Above the auroral arc the electron spectrum is harder and the fluxes are isotropic. It appears, based on 0.5 keV electron data, that various regions of precipitation which are associated with an auroral arc may move across L shells with different velocities. (IAA)

6256 PLASMA SHEET IN THE EVENING SECTOR. Burrows, J. R. (National Research Council, Ottawa). pp 179-197 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

Some factors are considered which contribute to asymmetry between the premidnight and postmidnight sectors of the plasma both in the equatorial plane and at low altitudes. In particular the greater probability of occurrence of extended auroral arcs in the premidnight sector is noted. The formation of these quiet arcs, their relationship to "inverted V" structures and their effect on energetic particle trapping are considered. It is concluded that the energetic electron "trapping boundary" is not necessarily the limit of closed field lines but instead is caused by wave turbulence in the plasma sheet at the most equatorward of the extended arcs. Various implications of this conclusion for plasma sheet structure are discussed. (auth)

6257 CALCULATIONS OF MAGNETOSPHERIC ELECTRIC FIELDS. Wolf, R. A. (Rice Univ., Houston, TX). pp 167-177 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

A description is given of efforts to compute theoretically the electric field and plasma distributions in the magnetosphere. New model calculations are concerned with a model particle population that simulates the typical quiet time ring current. A possible observational test of the model is discussed. Attention is given to a predicted asymmetry of the quiet time ring current. The predicted asymmetry between noon and dawn or dusk is large only if a substantial part of the total 50 kV drop across the polar cap exists on the sunlit part of the ionosphere. (IAA)

6258 FIELD ALIGNED CURRENTS IN THE MAGNETOSPHERE. Armstrong, J. C. (Johns Hopkins Univ., Silver Spring, MD). pp 155-166 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

Well-established facts concerning field aligned currents are briefly reviewed and new three axis magnetometer data from the 800 km altitude polar orbiting TRIAD satellite are presented. A current sheet flowing away from the earth at the poleward boundary of the current region for the local times being considered appears to be a permanent feature. The high altitude satellites demonstrate the existence of field aligned currents in the outer portions of the magnetosphere and show how they relate to the plasma sheet and the dayside cusp. (IAA)

6259 SUBSTORM INJECTION BOUNDARIES. McIlwain, C. E. (Univ. of California, San Diego, La Jolla). pp 143-154 of Magnetospheric Physics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1974).

From proceedings of the Summer Advanced Study Institute; Sheffield, England (13 Aug 1973).

An improved magnetospheric electric field model is used to compute the initial locations of particles injected by several substorms. Trajectories are traced from the time of their encounter with the ATS-5 satellite backwards to the onset time given by ground-based magnetometers. A spiral shaped inner boundary of injection is found which is quite similar to that found by a statistical analysis. This injection boundary is shown to move in an energy dependent fashion which can explain the soft energy spectra observed at the inner edge of the electrons plasma sheet. (auth)

6260 CHARGE RATIO OF ULTRA HIGH ENERGY COSMIC RAY MUONS. Ashley, G. K. II. Salt Lake City; Univ. of Utah (1974). 55p. University Microfilms Order No. 75-10,087.

Thesis (Ph. D.).

The data analysis and report of the results of the final charge-ratio experiment using the Utah cosmic-ray muon detector is described. Values for the charge ratio were obtained from least-squares fits to the observed bending-angle distributions. The fitting function was the result of folding the noise scattering distribution into the ideal local-spectrum bending distribution, with the charge ratio as the parameter of the fit. This method permitted a greater precision while circumventing the main causes of charge-ratio dilution. The average value 1.378 +- 0.015 for muon momentum at production between 1 and 8 TeV/c corresponding to a medium primary cosmic-ray momentum range 8 - 61 TeV/c is obtained. With the results of this experiment the charge ratio is precisely known over about three decades of muon energy beginning around 10 GeV. Thus, we believe the charge ratio can serve as a touchstone in determining the hadronic interaction dynamics and composition of the primary cosmic rays. Already approximate agreement has been obtained with experimental results from predictions utilizing the scaling/limiting-fragmentation hypothesis and constant composition of the primary cosmic rays. (Diss. Abstr. Int., B)

6261 FAST HISSLERS: A FORM OF MAGNETOSPHERIC RADIO EMISSIONS. Siren, J. C. Stanford, CA; Stanford Univ. (1974). 137p. University Microfilms Order No. 75-6926.

Thesis (Ph. D.).

Auroral radio hiss bursts in the frequency range 2-18 kHz have been observed, with rise or turn-on-times of 20-50 ms, and fall or turn-off times of 20-80 ms. These time scales are too brief to reconcile with the Cerenkov radiation emission mechanism often proposed as the transducer that converts precipitating auroral electron kinetic energy into very-low-frequency radio wave energy. The auroral hiss bursts, called here "fast hisslers," are observed to be "dispersed," that is, their arrival time at the receiving site is not simultaneous at all frequencies, but depends on frequency in a way that is consistent with propagation in the whistler mode of electromagnetic wave propagation. Since whistler mode wave propagation at these frequencies occurs only in the earth' magnetosphere, it is inferred that these fast hisslers are of magnetospheric origin. On the assumption that all the observed dispersion results from whistler mode dispersion at high latitudes, altitudes of origin of 1800 km to 30,000 km are calculated for these emissions. Fine details of some of the amplitude spectra of fast hisslers have been examined. Potential double layers have been investigated as a highly localized region of acceleration of the auroral electrons that are believed to be the source of energy of the fast hisslers. Evidence is strong that a plasma instability exists which rapidly converts electron kinetic energies into whistler-mode wave energy traveling in the same direction relative to the rest frame of the thermal magnetospheric plasma. (Diss. Abstr. Int., B)

6262 PENETRATION OF FAST PARTICLES INTO MAGNETOSPHERE. Part 2. Podgornyi, I. M.; Dubinin, E. M.; Potanin, Yu. N. pp 327-350 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

Penetration of fast charged particles into the artificial magnetosphere formed at the interaction of plasma flux with the magnetic field of dipole has been studied. Parameters of plasma and the energy of fast electrons has been chosen according to the principle of limited modeling. On the day-side penetration takes place through the slits in the polar regions. They are prolonged in the night-side. The penetration of particles into the magnetosphere through the equatorial slits beginning on the day-side and prolonged in the plasma sheet on the night-side, has been discovered. Part of the particles penetrated into the plasma sheet, enters into the magnetosphere forming the radiation belt. Mechanism of trapping proves to be of convection type. Drifting around the dipole axis, the electrons trapped by the magnetic field precipitate on the day-side thus forming the low-latitude auroral region. The high-latitude region of precipitation is connected with the direct penetration of particles through the polar slits. (auth)

6263 STRUCTURE OF THE PECULIAR POINTS ON THE MAGNETOSPHERE SURFACE. Reuchvarger, Z. B.; Syrovatskii, S. I. pp 355-364 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminar Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

In the approximation of two-dimensionous model of ideal magnetosphere, some problems of the structure of non-regular peculiar points on the magnetosphere surface in which the strength of force lines are splitting, have been investigated. It has been shown that for any angular dependence of gaseous pressure which has physical meaning, the magnetosphere near the peculiar point has the form $y = \text{const} \cdot x^{\frac{1}{3}}$. It has been revealed that for sharp anisotropy of the angular distribution function far from the Earth, the pressure in the peculiar point may be much higher than far from it, which promotes the penetration of solar particles on great depth into the magnetosphere in the vicinity of magnetic poles.

6264 SOLAR COSMIC RAY PENETRATION INTO THE EARTH'S MAGNETOSPHERE. Tverskoi, B. A.; Derchieva, L. A.; Ivanova, T. A.; Koval'skaya, I. Ya.; Panasyuk, M. I.; Sosnovets, E. N.; Tverskaya, L. V.; Tel'tsov, M. V. pp 365-385 of 5 Leningradskii Mezhdunarodnyi Seminar Materialy Mezhdunarodnogo Seminara Solnechnye Kosmicheskie Luchi i Ikh Proniknovenie v Magnitosferu Zemli. Kocharova, G. E.; Dergacheva, V. A. (eds.). Leningrad; NII Yadernoi Fiziki Moskovskogo Gosuniversiteta (1973). (In Russian)

From 5th international seminar on solar cosmic rays and their penetration into the Earth's magnetosphere; Leningrad, USSR (26 Jun 1973).

The features of low-energy solar cosmic ray penetration into the high-latitude geomagnetospheric regions are discussed. The Cosmos-480 data are used to analyse the case of north-south asymmetry in the $E_p > 1$ MeV solar proton distribution over polar caps on April 18, 1972 when the southern cap proton flux was 10 times as high as the northern flux for ~10 hours. In the northern and southern auroral latitudes the solar proton intensity was comparable with that over the southern polar cap. The variations, $\Delta\lambda$, are studied of the latitude of the region of proton penetration to auroral latitudes. Such variations are assumed to be connected with changes in the plasma sheet depth during geomagnetic disturbances. Possible mechanisms of solar cosmic ray penetration into the Earth's magnetosphere are discussed. Variations in the 130-420 keV solar proton spectrum during the magnetic storm sudden commencement on August 16, 1970 are considered. (auth)

6265 PLASMASPHERIC HISS OBSERVATIONS IN THE EVENING AND AFTERNOON QUADRANTS. Parady, B. K.; Eberlein, D. D.; Marvin, J. A.; Taylor, W. W. L.; Cahill, L. J. Jr. (Univ. of Minnesota, Minneapolis). 80: No. 16, 2183-2198(1 Jun 1975).

An instrument to detect the magnetic components of ELF signals propagating in the magnetosphere was carried on Explorer 45. Over 600 hours of observations in the inner magnetosphere near the equatorial plane have been examined. These observations were obtained in late 1971 and the first half of 1972 when the satellite apogee was in the evening and afternoon quadrants. The strongest most persistent signals were plasmaspheric hiss from a few hundred to a few thousand hertz. Broad band signals of 25 m gamma were common. Frequently, the hiss terminated abruptly during a satellite pass near and inside the boundary of the plasmasphere. Hiss boundaries were observed usually beyond L equals 4 in quiet times, Kp equals 0 to 1 +, but were frequently beyond apogee near L equals 5. During disturbed times, Kp greater than 4 +, hiss boundaries remained near L equals 5 from 1600 to 1900 LT but were below L equals 4 from 2000 to 2400 LT. The magnetic index best correlated with the hiss boundary near midnight was Dst, the ring current index. The boundary location near midnight ranged from L equals 2.5 for Dst equals -160 gamma to L equals 5.5 for Dst equals 0. The peak intensity of hiss during an orbit occurred most frequently in the afternoon about 1 R/sub E/ inside the hiss boundary. The most intense hiss was observed in the recovery phase of magnetic storms at the inner edge of the ring current. The source of the hiss appears to be the outer plasmasphere. Generation of hiss through cyclotron resonance with energetic electrons is the probable source for most of the hiss. Ring current protons, forming a peak in the proton flux between 10 and 100 keV, may be a source for some of the hiss. (auth)

6266 INTERPRETATION OF LOW-ENERGY PARTICLE ACCESS TO THE POLAR CAPS. Michel, F. C.; Dessler, A. J. (Rice Univ., Houston, TX). 80: No. 16, 2309-2310(1 Jun 1975).

Neither particle access to the polar caps by motion along magnetospheric field lines connected to the interplanetary field (in the "open" model) nor particle access to the polar caps by combined diffusive and convective motion across magnetospheric field lines (in the "closed" model) adequately explains the available data. The fact that data exist that are difficult to interpret with one model does not automatically confirm the other model. (auth)

6267 ELECTRON DISTRIBUTION MOMENTS AND PRECIPITATION DEPENDENCE ON ANISOTROPIC MAGNETOSPHERIC CONTENT. Catchpoole, J. R. (Mitchell Coll. of Advanced Education, Bathurst, Australia). Aust. J. Phys.; 28: No. 1, 77-83(Feb 1973).

Precipitation of spiralling electrons from the magnetosphere is investigated, under acceleration by field line convergence and by superimposed electric field. Instead of an isotropic content, packets of electrons of fairly narrow pitch range are considered. These are treated as initially normally distributed about those angles which contribute most to the precipitation. Calculations indicate the effects on the pitch distribution and on the total magnitude of precipitation. The importance of these effects lies in the critical dependence of subsequent collision atmosphere phenomena on such details of distribution. A comparison of total precipitation is made with the isotropic case for various parameters. As measures of the acceleration and trapping modifications, the third and fourth moments of the electron distributions are indicated. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

6268 (SAND-75-0217) PROGRAM DIODE AND ITS USE IN E-BEAM DIAGNOSTICS. Phillips, A. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 56p. Dep. NTIS $5.50.

Typical input data deck structure, the options available to the user, the data processing methods, and the presentation of output are described for the computer program series DIODE. (GHT)

6269 (SAND-75-5490) DEPTH PROFILING OF DEUTERIUM AND HELIUM IN METALS BY ELASTIC PROTON SCATTERING: A MEASUREMENT OF THE ENHANCEMENT OF THE ELASTIC SCATTERING CROSS SECTION OVER RUTHERFORD SCATTERING CROSS SECTION. Langley, R. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 15p. (CONF-750949-4). Dep. NTIS $4.00.

From international conference on ion beam surface layer analysis; Karlsruhe, F.R. Germany (15 Sep 1975).

Ion backscattering was used to observe deuterium and helium in thin films on thick substrates. With this technique, the elastic scattering cross section for protons on deuterium at 170°C (lab) was found to be approximately 140 times greater than the Rutherford cross section at 2.0 MeV and approximately 260 times greater at 2.8 MeV. For protons incident on ^{4}He, the elastic cross section is increased over the Rutherford cross section by approximately 300 at 2.8 MeV. A discussion of the experimental setup, results of the measurement of the reaction cross section, a demonstration of the technique on specially-prepared films and a description of an analytical technique to provide impurity concentration vs depth from yield vs energy spectra are given. (6 figures, 13 references) (GHT)

6270 ANALYSIS OF SURFACE SPUTTERING ON A QUANTUM STATISTICAL BASIS. Wilhelm, H. E. Paper 75-401. New York; American Institute of Aeronautics and Astronautics (1975). 5p.

From 11th electric propulsion conference; New Orleans, Louisiana (19 Mar 1975).

Surface sputtering is explained theoretically by means of a 3-body sputtering mechanism involving the ion and two surface atoms of the solid. By means of quantum-statistical mechanics, a formula for the sputtering ratio S(E) is derived from first principles. The theoretical sputtering rate S(E) was found experimentally to be proportional to the square of difference between incident ion energy and the threshold energy for sputtering of surface atoms at low ion energies. Extrapolation of the theoretical sputtering formula to larger ion energies indicates that S(E) reaches a saturation value and finally decreases at high ion energies. The theoretical sputtering ratios S(E) for wolfram, tantalum, and molybdenum are compared with the corresponding experimental sputtering curves in the low energy region from threshold sputtering energy to 120 eV above the respective threshold energy. Theory and experiment are shown to be in good agreement. (IAA)

6271 EQUIPMENT FOR EXPERIMENTS IN THE STUDY OF ORIENTATIONAL EFFECTS WHICH ACCOMPANY THE CHANNELING OF PROTONS. Karandashov, V. G.; Rudnev, A. S.; Sirotinin, E. I.; Shishkin, K. S. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 586-588(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 204-207(1975).

An experimental device is described which is designed for the study of orientational effects. The device contains a goniometer equipped with step motors for performing angular displacements, and electronic blocks which allow partial automation of the measurement process. (auth)

Atomic and Molecular Properties

Refer also to abstract 6303.

6272 (CONF-750844-1) IONIZATION BY NUCLEAR TRANSITIONS. Freedman, M. S. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 18p. Dep. NTIS $4.50.

From summer course in atomic physics; Carry-le-Rouet, France (31 Aug 1975).

A phenomenological description of ionization events is given that applies to both shaking transitions of the composite nucleus-atom system and the process in which the charged particles emitted in a nuclear decay transfer energy by a relatively slow "direct collision" final state interaction with atomic electrons. Specific areas covered include shakeoff in internal conversion, shakeoff in electron capture, shakeoff in beta decay, and inner electron ejection in alpha decay. (5 figs., 1 table) (GHT)

6273 (COO-2753-11) LIFETIMES AND FLUORESCENCE YIELDS OF THREE-ELECTRON IONS. Bhalla, C. P.; Gabriel, A. H. (Kansas State Univ., Manhattan (USA); UKAEA Research Group, Abingdon, Culham Lab.). 1975. 7p. (CONF-750975-1). Dep. NTIS $4.00.

From 4th international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Theoretical total rates of the various levels for the 1s $2p^2$, 1s $2s^2$ and 1s 2s 2p configurations are presented for atomic numbers 7, 8, 10, 16 and 26. The line fluorescence yields for these cases are also listed. (auth)

6274 ASPECTS OF THE TWO-BODY TREATMENT OF THE H-ATOM. Janossy, L. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 37: No. 4, 355-362(1974).

The excitation of an H-atom by an incident monochromatic wave is dealt with using the two-body wave function of the atom. It is shown that this method gives results resembling very strongly the classical results obtained by H. Hertz. (auth)

6275 DETERMINATION OF THE SPONTANEOUS RADIATIVE TRANSITION RATE OF THE 2^3S_1 yields 1^1S_0 TRANSITION IN NEUTRAL HELIUM. Woodworth, J. R. Baltimore; Johns Hopkins Univ. (1974). 166p. University Microfilms Order No. 75-12,973. Thesis (Ph.D.).

The radiative transition rate of the 2^3S_1 yields 1^1S_0 transition in He I has been the subject of theoretical investigation for a considerable length of time. This experiment measured the single photon radiative transition rate of the 2^3S_1 yields 1^1S_0 transition by creating a known number of He 2^3S_1 metastables and then measuring the number of photons per second they radiated at 625.56 A, the wavelength corresponding to the 2^3S_1 yields 1^1S_0 transition. A weak emission feature at 625.56 A +- 0.05 A was observed in these experiments. Arguments that this feature is due to the 2^3S_1 yields 1^1S_0 transition are presented. No variation in the transition rate was observed when the pressure in the light source was varied from 0.045 Torr to 0.68 Torr. The value for the radiative transition rate obtained in these experiments was 1.10 x 10^{-4} per second, with a 2 sigma uncertainty of a factor of 1.26. A comparison of this value to the theoretical value of 1.27 x 10^{-4} per second is given. The relevance of this work to beam-foil experiments which have measured the 2^3S_1 yields 1^1S_0 transition rate for high Z He-like ions is also discussed. (Diss. Abstr. Int., B)

6276 QUANTUM CRYSTAL CALCULATION FOR SOLID MOLECULAR HYDROGEN. Wu, W. S. (Taiwan Provincial Coll. of Education, Changhua); Wang, S. Y. Chin. J. Phys. (Taiwan); 12: No. 2, 79-86(Oct 1964).

The quasicrystal approximation of Woo and Massey is employed to compute the ground state energy of solid molecular hydrogen using (i) a Lennard-Jones 6-12 potential, and (ii) a Buckingham exp-6 potential. The densities considered range from 2.67×10^{-2} to 5.57×10^{-2} Å^{-3}, corresponding to pressures up to about 20 kbar. Results obtained with the exp-6 potential are in good agreement with the earlier work of Krumhansl and Wu, even though the present work is carried out using a more rapidly convergent cluster expansion procedure. This suggests that short-range correlations become ineffectual at high densities, rendering the solid more Hartree than quantum, as was first suggested by Krumhansl. Results obtained with the Lennard-Jones potential are in substantially better quantitative agreement with experiment. (auth)

6277 L SUBSHELL FLUORESCENCE YIELDS AND COSTER-KRONIG TRANSITIONS AT Z = 70. McNelles, L. A.; Campbell, J. L.; Geiger, J. S.; Graham, R. L.; Merritt, J. S. (Guelph Univ., Ont.). Can. J. Phys.; 53: No. 14, 1349-1359(15 Jul 1975).

The nine L subshell radiative and nonradiative deexcitation probabilities, ω_i and f_{ij}, have been determined for the atom Yb (Z = 70) by conversion electron-X-ray coincidence measurements. The results are in good agreement with theoretical values calculated by McGuire using a simple approximation to the Herman-Skillman potential. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 6466.

6278 (COO--2184-7) PROGRESS REPORT FOR NUCLEAR CHEMISTRY PROJECT. Period Covered: October 1, 1974--September 30, 1975. (Princeton Univ., N. J. (USA). Dept. of Physics). 30 Jun 1975. Contract E(11-1)-2184. 27p. Dep. NTIS $5.00.

Research on investigations of chemical bonding influences on the moderation and capture of negative mu mesons when stopped in matter, nuclear energy levels, internal fields in solids, and the validity of certain semiclassical approximations made in the treatment of nuclear rotational motion. (JFP)

6279 (JINR-P1-9136) INVESTIGATION OF THE ATOMIC CAPTURE AND TRANSFER OF π^--MESONS IN THE HYDROGEN MIXTURES WITH OTHER GASES. Petrukhin, V. I.; Suvorov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The atomic capture and transfer of π^--mesons in the gaseous mixtures H_2 + Z have been studied where Z is He, Ne, Ar, Kr, Xe and N_2, CO_2. The relative probabilities of the atomic capture of pions by the mixture components have been measured as well as the constants Λ_Z of the pion transfer from the hydrogen atoms by Z atoms. It is shown that the relative stopping power S_0^H of Z atoms, at the pion energies when the atomic capture takes place, and the transfer constants Λ_Z equally weakly depend on $Z(\sim Z^{\frac{1}{2}})$. The transfer constants Λ_Z weakly depend on the admixture concentration $C = n_Z/n_H$. (auth)

6280 RELAXATION OF μ^+ MESON SPIN IN GERMANIUM IN LONGITUDINAL MAGNETIC FIELDS. Gurevich, I. I.; Nikol'skii, B. A.; Selivanov, V. I.; Sokolov, B. V. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 3, 806-810(Mar 1975). (In Russian)

On basis of measurements of the relaxation rate of the μ^+ meson spin it is concluded that a long-lived bound paramagnetic state Mu (μ^+e^-) should exist in germanium; at temperatures between 170 and 300K it should be formed in about ~70% of cases. The parameters defining the relaxation rate of the μ^+ meson spin in this state are estimated. (auth)

6281 POSITRON ANNIHILATION IN DEFECTIVE ALKALI-HALIDE CRYSTALS. Vorob'ev, A. A.; Aref'ev, K. P.: Vorob'ev, S. A. (Tomsk Polytechnic Inst., USSR). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1486-1490(Apr 1975). (In Russian)

Positron annihilation is investigated in alkali-halide single crystals irradiated by electrons and containing cation vacancies. KCl (42%)-KBr (58%), KCl, KBr, NaCl. The main annihilation characteristics (angular distribution of annihilation radiation, probabilities for 3γ annihilation, time distribution of positron annihilation) are found to vary with variation of crystal deficiency. The experimental data obtained can be satisfactorily explained by the model of a "positron-exciton" complex near the cation vacancy. (auth)

6282 REACTION OF POSITRONIUM ATOMS WITH NITROGEN DIOXIDE. Tatur, A. O.; Mokrushin, A. D. High Energy Chem. (USSR) (Engl. Transl.); 9: No. 2, 166-167(1975).

Translated from Khim. Vys. Energ.; 9: No. 2, 188(1975).

The intensity of the narrow component and the rate constants for positronium conversion on NO_2 and for the trimolecular addition reaction of positronium to NO_2 are found. (JFP)

6283 MUONIC ATOMS. I. Theoretical Value of the Hyperfine Structure of Muonic Helium. II. Theoretical Analysis of Muonic X-Rays from Low-Z Atoms. Huang, K. N. New Haven; Yale Univ. (1974). 181p. University Microfilms Order No. 75-11,291.

Thesis (Ph. D.).

It may be possible to form the muonic helium atom (alpha mu^-e^-) and to measure its hyperfine structure interval in the ground state. In the simplest approximation this atom can be considered to be hydrogenlike with alpha mu^- as the nucleus and a single electron. Hence in the lowest approximation the hfs splitting, DELTA nu, (which is inverted) is given by the Fermi Formula and differs from the muonium DELTA nu by reduced mass effects. The principal corrections, which contribute about 24 MHz to the splitting, arise from the relativistic, radiative, and reduced mass effects. The largest correction to the hfs in the penetration of the electron within the alpha mu^- nucleus. Because the relevant Schroedinger equation cannot be solved exactly, numerical wave functions in a Hylleraas-basis are computed. The computation of the hyperfine structure of the ground state of muonic helium with a 35 term wave function gives an extrapolated value DELTA nu equals 4494.552 MHz. High precision measurements using a crystal diffraction spectrometer of muonic X-rays from low-Z atoms are planned to test QED, measure muon mass, and study the nuclear charge distributions. The energy levels are obtained by solving numerically the Dirac equation for the muon with finite nuclear charge distribution. Several corrections to these energies are also calculated which include the reduced mass correction, the radiative correction and the electron screening. The problem of electron screening remains the major theoretical difficulty in the analysis of X-rays from muonic atoms. In low-Z cases the Hartree-Fock formalism is inadequate for obtaining highly accurate energies and other expectation values due to lack of correlation of the interacting particles. The Hylleraas-type wave functions which explicitly contain interparticle coordinates are computed. (Diss. Abstr. Int., B)

6284 ANGULAR CORRELATION OF THE TWO-PHOTON POSITRON ANNIHILATION QUANTA IN SILICON DIOXIDE POWDERS. Debowska, M.; Kukulka, J.; Wesolowski, J. (Wroclaw Univ.). Acta Phys. Pol.; A48: No. 4, 583-585(Oct 1975).

Angular correlation measurements of the two-photon annihilation quanta were made on aerosils: 50, 200 and 300 in vacuum and in air. Using correlation curves obtained by experimental methods, the increase in intensity of the narrow component ΔI_{exp} in air, compared with that in vacuum, was determined. The values of ΔI_{exp} compared with those of ΔI_{theor}, anticipated on the assumption that there occurs o-Ps conversion by oxygen paramagnetic molecules in air, were found in the instance of the aerosils 200 and 300 to be definitely higher than those expected. This effect is not easy to interpret and requires further investigations of the physical and chemical properties of the grain surface. (auth)

6285 POSITRONIUM FORMATION IN POLYACENAPHTYLENES. Goworek, T. (Univ. Marii Curie-Sklodowskiej, Lublin); Rybka, C. Acta Phys. Pol.; A48: No. 4, 587-589(Oct 1975).

Positronium formation in the polyacenaphtylene was investigated. It was found that the creation of positronium atoms is, to a large extent, ruled by disordering of the structure rather than by flexibility of the polymer chains. (auth)

6286 MOLECULAR COMPLEX FORMATION BETWEEN POSITRONIUM AND ORGANIC MOLECULES IN SOLUTIONS. Madia, W. J.; Nichols, A. L.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Am. Chem. Soc.; 97: No. 18, 5041-5049(3 Sep 1975).

Evidence is presented which supports the reversible formation of molecular complexes between Ps atoms and a series of nitrobenzene derivatives and p-benzoquinone in solution. The activation energy for the forward reaction step I (Ps + M (II) reversible PsM (I)) is generally very small; E/sub A/ approximately 1 kcal/mol. DELTA H/sub EQ/, the enthalpy of the overall process, ranges from almost zero, in the case of very unreactive substrates such as toluene or heptane, to -8 kcal/mol for dinitrobenzene or p-benzoquinone. The reactivities of the various substrate molecules toward Ps follow trends as observed in conventional molecular complex formation. Furthermore an attempt was made to assess the role of the solvent upon the stability of the molecular complexes. (auth)

6287 POSITRON ANNIHILATION IN AgBr MICROCRYSTALS. Kelley, T. M.; Quick, N. R. (Eastman Kodak Co., Rochester, NY). J. Appl. Phys.; 46: No. 8, 3278-3281(Aug 1975).

Positron decay rates have been measured in pure silver bromide microcrystals subjected to various surface treatments before and after exposure. Two distinct decay rates are observed in most samples. The results show no difference between the positron decay spectra in microcrystals exposed to uv light relative to unexposed samples, indicating that the chemical transitions induced on the surfaces of silver halide grains by the photographic process are in too low concentration to be detectable by the positron-lifetime technique. (4 figures, 2 tables, 12 references) (auth)

6288 LIFETIME OF THE 2S METASTABLE LEVEL IN MUONIC HYDROGEN. Gorini, G.; Torelli, G. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 13: No. 14, 517-521(2 Aug 1975).

An estimate is made, for experiment planning, of the lifetime of the 2S metastable level in muonic hydrogen. The estimate was made from measured values of the cascade time of pions in hydrogen and helium, and the measured disappearance rate of the 2S level in muonic helium. (21 refs.) (GHT)

Collision Phenomena

Refer also to abstracts 6221, 6273, and 6585.

6289 LARGE ANGLE SCATTERING OF FAST K^+ IONS IN COLLISIONS WITH N_2 AND CO MOLECULES. Inouye, H.; Niurao, K.; Kita, S. (Tohoku Univ., Sendai). Chem. Phys. Lett.; 33: No. 2, 241-244(1 Jun 1975).

Large angle scattering of fast K^+ ions in collisions with N_2 shows only one cut-off, while two cut-off angles appear in K^+-CO scattering. Differences in these cut-off angles result primarily

from the different masses involved in K^+-N, K^+-C, and K^+-O scattering. (auth)

6290 DETERMINATION OF THE K^+–Ar POTENTIAL FROM TOTAL CROSS SECTION MEASUREMENTS. Budenholzer, F. E.; Galante, J. J.; Gislason, E. A.; Jorgensen, A. D. (Univ. of Illinois, Chicago). Chem. Phys. Lett.; 33: No. 2, 245-249(1 Jun 1975).

Total scattering cross sections have been measured for K^+ and Ar, and the potential has been determined in the range 2.4Å to 5.5Å. Novel methods of analyzing and displaying the data are described. The probable source of a systematic error in an earlier scattering study of K^+ and Ar is identified. The measured potential agrees well with other work on this system. (2 figs, 19 refs) (auth)

6291 FINE STRUCTURE TRANSITION CROSS SECTIONS FOR SEVERAL ALKALI + RARE GAS SYSTEMS. Olson, R. E. (CEN de Saclay, Gif-sur-Yvette, France). Chem. Phys. Lett.; 33: No. 2, 250-253(1 Jun 1975).

The energy dependence, $E_{c.m.} \leq 0.2$ eV, of the inelastic total cross sections for the $^2P_{\frac{1}{2}} \rightarrow {}^2P_{\frac{3}{2}}$ fine structure transition of the lowest excited states of the alkali atoms are calculated for the following systems: Na, K, Rb + He, Ne, Ar, and Cs + He. Encouraging agreement between theory and experiment is obtained. (4 fig, 15 refs) (auth)

6292 LOW ENERGY RESONANT SCATTERING OF ELECTRONS BY THOMAS–FERMI ATOMS. Berezina, N. B.; Demkov, Yu. N. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 3, 848-854(Mar 1975). (In Russian)

Scattering of electrons by atoms in the energy range from a fraction of an electron-volt to the first excitation potential is considered within the framework of the statistical model. It is of interest to elucidate the effect of energy levels entering the continuous spectrum with decrease of the atomic nucleus charge on the scattering process. The quasistationary states which are formed and whose width is calculated may be the cause of the appearance of a number of broad resonances in the slow electron scattering cross section. Curves of the dependence of the resonance scattering cross section on incident electron energy are presented for a number of atoms ($22 \leq z \leq 26$). These curves yield information on variation of the shape and positions of the resonances on variation of the nuclear charge z. The behavior of the scattering length near the point of contact of the s-levels and the boundary of the continuous spectrum is analyzed. (auth)

6293 ELECTRON EXCHANGE CROSS SECTION IN COLLISIONS BETWEEN DEUTERIUM ATOMS AND HYDROGEN OR HELIUM. Ab'yasevich, B. P.; Antonenko, V. G. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.: 68: No. 3, 889-893(Mar 1975). (In Russian)

Estimates are obtained for the electron exchange cross sections σ_{00} in collisions between fast deuterium atoms ($E_d \approx 100$ keV) and helium ($\sigma_{00} = (4.0 \pm 0.6) \cdot 10^{-16}$ cm^2 for $E_d = 160$ keV) or hydrogen ($1.7 \cdot 10^{-16}$ cm$^2 > \sigma_{00} > 0.1 \cdot 10^{-16}$ cm^2 in the range of E_d from 90 to 300 keV). A method is suggested for determining the cross sections σ_{00} in a broad energy range by measuring the depolarization of beams traversing gaseous targets. (auth)

6294 IONIZATION OF K SHELLS OF ATOMS AND IONS IN COLLISIONS WITH ELECTRONS. Gorshkov, V. G.; Karpeshin, F. F.; Mikhailov, A. I. (Leningrad Inst. of Nuclear Physics). Zh. Eksp. Teor. Fiz.; 68: No. 3, 894-907(Mar 1975). (In Russian)

The differential cross section for ionization of the K shell of atoms by electron impact is obtained for incident electron energies E which considerably exceed the binding energy and for arbitrary values of the momentum q transferred to the nucleus. Some features of the cross section with respect to momentum transferred to the atom as a whole are investigated in the region of large q values. (auth)

6295 ORBITING-TYPE OSCILLATIONS IN THE TOTAL CHARGE EXCHANGE CROSS SECTION FOR THE p + H(1s) → (H1s) + p REACTION. Matveenko, A. V.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 3, 920-928(Mar 1975). (In Russian)

A detailed calculation is performed for the charge exchange reaction between protons and hydrogen atoms in the $10^{-2} \leq E \leq 0.7$ eV energy range. Oscillations with an amplitude ~0.1 about the mean value of the cross section are observed in the total cross section. The oscillatory structure of the cross section is ascribed to orbiting near the top of the centrifugal barriers of the effective potentials of the problem. A phase analysis of the charge exchange cross section is carried out. (auth)

6296 TRANSITIONS BETWEEN ^2P AND ^3P MULTIPLET SUBLEVELS IN COLLISIONS BETWEEN ATOMS AND IONS. Gurevich, A. I.; Satarov, L. M. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1265-1273(Apr 1975). (In Russian)

The cross sections for transitions between ^2P and ^3P multiplet sublevels in collisions between various types of atoms and ions are considered. The calculation carried out is based on the assumption of smallness of energy splitting between the respective sublevels and on the multiplets being more or less isolated from the other terms. The results of the investigation may be of interest for a theoretical investigation of gas lasers involving elements considered in the paper. (auth)

6297 METHOD OF CALCULATING THE TIME-DEPENDENT DISTRIBUTION FUNCTION OF MODERATIVE PARTICLES FOR AN ARBITRARY ENERGY LOSS. Medvedev, Yu. A.; Metelkin, E. V.; Stepanov, B. M.; Fedorovich, G. V. At. Energ. (USSR); 38: 156(1975).

A method of calculating the time-dependent distribution function of electrons slowing-down in gas as a result of elastic and nonelastic collisions has been developed. Electron absorption due to their interaction with electronegative molecules was taken into account. The results obtained can be used in investigating the slowing-down of neutrons and other particles. (8 references) (auth)

6298 NUMERICAL APPROACH TO THE SOLUTION OF COUPLED EQUATIONS INVOLVED IN ELECTRON–ION AND ELECTRON–ATOM SCATTERING PROBLEMS. Smith, E. R. (Air Force Cambridge Research Labs., Bedford, MA). J. Comput. Phys.; 18: No. 2, 201-223(Jun 1975).

A numerical procedure is outlined which treats the coupled equations involved in electron-ion scattering, as well as electron-atom scattering, within the close-coupling formalism. The coupled integrodifferential equations of the scattering problem are solved by a two-step process. First, the equations are separated into auxiliary equations which are then solved numerically in the interior region from zero out to some transformation point r/sub t/. Any convenient numerical technique can be used to integrate the equations; in this work, a noniterative integral equation method is used. Next, the long-range potential terms are taken into account at r/sub t/ via an open-channel projection technique. This technique simply projects the reactance matrix to its asymptotic value. The numerical procedure is then tested by applying it to e–He^+ scattering. Finally, two specific disadvantages of the procedure related to the treatment of closed channels are discussed in detail. (25 references) (auth)

6299 RELATIVISTIC CORRECTIONS TO CHARGE TRANSFER SCATTERING. Das, J. N. (University Coll. of Science, Calcutta); Konar, A. N. Acta Phys. Acad. Sci. Hung.; 37: No. 4, 291-294(1974).

Relativistic corrections to charge transfer scattering of protons on hydrogen has been calculated in a semi-relativistic treatment and a qualitative discussion of the result has been given. (auth)

6300 ELECTRON ENERGY DISTRIBUTION FUNCTION IN CARBON DIOXIDE FOR A VERY HIGH FREQUENCY FIELD. Valiev, Kh. V. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 91-93(1975). (In Russian).

In connection with the creation of CO_2 plasmotron and lasers, by investigating the high-frequency breakdown in this gas the electron energy distribution function can give a detailed physical description of processes taking place in the gas. Since only steady-state conditions are required for most problems, the Boltzmann equation for the spherically symmetric member of the distribution function is presented. To solve this equation it is necessary to know the frequency of momentum transfer ν_m as a function of energy, and also to take into account the electron energy losses to electronic and oscillatory excitations and to ionization of CO_2 molecules. Dissociation of carbon dioxide is not considered. An approximate calculation of the distribution function is based on an analytical approximation of experimental results in the literature on radial cross-sections for momentum transfer and inelastic scattering of electrons in carbon dioxide. The problem is complicated by the fact that a simple dependency of these cross-sections on energy is lacking. The electron energy distribution function was determined for the conditions $\nu_m \gg \omega^2$ and $\omega^2 \gg \nu_m^2$ (collisions are rarer). (SJR)

6301 K X-RAY PRODUCTION IN COLLISIONS OF CHLORINE AND SULFUR IONS WITH THIN, GAS TARGETS AT 0.1 TO 1.5 MeV/amu. Winters, L. M. Manhattan, KS; Kansas State Univ. (1974). 54p. University Microfilms Order No. 75-2540.

Thesis (Ph. D.).

Cl K x-ray-production cross sections were measured in single collisions of 0.1- to 1.5-MeV/amu Cl ions with gas targets of He, N_2, Ne, SiH_4, H_2S, HCl, Ar, Kr, and Xe. Cross sections for Ne K, Si K, S K, Ar K, Kr L, and Xe L x-ray production and yields for Xe M x rays were also measured. Similar measurements for both Cl and S ions were made at one velocity as a function of projectile charge state, q, for 5 less than or equal to q less than or equal to 11. Except at the highest energies, projectile K x-ray-production cross sections are nonmonotonic as a function of target atomic number, Z_2. Anomalously high target and projectile cross sections occur in the symmetric region: Z_2 approximately equal to 17. For all x-ray lines, the cross sections show an approximate exponential increase with increasing q at constant projectile velocity, with the rate of increase being greatest in the symmetric region. The experimental results indicate the importance of one-step molecular processes suggested by Meyerhof in producing K vacancies. The 2psigma-2p pi transition may be of importance when initial 2p vacancies are carried into K-vacancy-producing collisions. The large cross sections for both target and projectile in nearly-symmetric collisions gives evidence for K-vacancy transfer between collision partners. (Diss. Abstr. Int., B)

6302 ELASTIC AND INELASTIC SCATTERING OF CESIUM, CESIUM IODIDE, AND CESIUM CHLORIDE BY ARGON AND XENON IN THE CROSSED ATOMIC AND MOLECULAR BEAMS. Armstrong, W. D. Providence; Brown Univ. (1974). 125p. University Microfilms Order No. 75-9119.

Thesis (Ph. D.).

Velocity and angular distributions of cesium atoms and two cesium halide molecules scattered by rare gas atoms have been measured for the following systems at the indicated initial relative collision energies, anti E: Cs + Ar, anti E equals 0.94, 1.29, and 1.85 kcal/mole; Cs + Xe, E equals 1.15, 1.91, and 3.10 kcal/mole; CsI + Ar, anti E equals 1.06, 1.46, and 2.08 kcal/mole; CsCl + Ar, anti E equals 1.36, 1.63, and 1.94 kcal/mole; CsI + Xe, anti E equals 1.52, 2.52, and 4.09 kcal/mole. At the collision energies indicated the atom-atom scattering can only be elastic. Thus the experiments with those systems can be used for apparatus calibration and a standard of comparison for the diatom-atom experiments. The velocity distributions in the diatom-atom systems are analyzed for the relative contributions of elastic and inelastic scattering. (Diss. Abstr. Int., B)

6303 RELATIVE AND ABSOLUTE LEVEL POPULATIONS OF BEAM-FOIL EXCITED NEUTRAL HELIUM. Davidson, J. F. Tucson, AZ; Univ. of Arizona (1974). 146p. University Microfilms Order No. 75-11,923.

Thesis (Ph. D.).

The relative and absolute populations of excited levels in neutral helium have been measured. An experimental system was built and calibrated with a tungsten ribbon standard lamp. Helium was accelerated to 0.275 MeV by a Van de Graaff generator and passed through a carbon foil. Transitions in the spectral region between lambda 2829 A and lambda 5875 A were observed and the relative and absolute level populations per emergent neutral atom were calculated for the upper levels of the transitions. Beam geometry, polarization, cascading, and normalization were taken into account. The populations showed a dependence roughly proportional to the inverse cube of the principal quantum number, with no preferential populations of the ground state. Level populations with the same principal quantum number but different orbital angular momentum and spin were not proportional to the statistical weights of the levels. However, they showed a tendency to approach statistical behavior with increasing principal quantum number. The triplet and singlet spin level populations also differ from purely statistical population ratios. Further, these ratios exhibit a slight dependence on incident particle energy in the range 0.160 to 0.500 MeV. A measurement of excitation functions for the levels 4s ^{1}S, 4s ^{3}S, 3p^{1}P, 3p^{3}P, 4d^{1}D, 4d^{3}D in this same energy range shows that the number of these levels per emergent atom is increasing, although the total number of neutral atoms is decreasing. (Diss. Abstr. Int., B)

6304 INELASTIC ELECTRON SCATTERING. Methods Exp. Phys.; 3: 868-952(1974).

The discussion of the scattering of electrons by atoms and molecules includes the similarity of electron impact spectra intensities to those of optical absorption spectra in terms of the Born approximation, deviations from the Born approximation, apparatus for testing the approximate theory, highlights from relative intensity measurements, techniques for absolute intensity measurements, and the definition of a generalized oscillator strength in terms of collision cross sections. (JFP)

6305 7^{2}P MIXING AND QUENCHING IN CESIUM INDUCED IN COLLISIONS WITH HYDROGEN MOLECULES. Lukaszewicz, M. (Nicolas Copernicus Univ., Torun, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 4, 501-508(1975).

The excitation transfer and quenching cross sections for the 7^{2}P doublet components in caesium due to collisions with molecular hydrogen were determined experimentally using the sensitized fluorescence method. The temperature dependence of the experimental mixing cross section Q_{21} is explained on the basis of the Baylis theory. (auth)

6306 FORMATION AND ACCUMULATION OF AN EXCESS CONCENTRATION OF HOLES ON IRRADIATION WITH POSITRONS AND A NUMBER OF PHENOMENA CAUSED BY THE HOLES IN DIELECTRICS. Vorob'ev, A. A.; Aref'ev, K. P.; Vorob'ev, S. A. (Scientific-Research Inst. of Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Dokl. Akad. Nauk SSSR; 219: No. 5, 1092-1095(11 Dec 1974). (In Russian)

Optical absorption spectra were obtained under comparable conditions for single crystals of KCl-0.1 mol % Tl 0.75 mm thick irradiated with positrons and gamma quanta and separately with gamma quanta over a period of a month, and for single crystals of NaCl irradiated under analogous conditions. The spectra showed that the combined irradiation of NaCl crystals with positrons and gamma quanta induces a higher concentration of F-centers than in the case of irradiation with gamma quanta alone. Concentration of color centers in KCl-0.1 mol % Tl was smaller because of hole formation from the presence of the Tl^+ impurity. Decolorization phenomena in irradiated KBr can be explained by the decay of unstable, electron, color centers which are formed as a consequence of positron annihilation and the creation of a hole, volumetric charge. (SJR)

6307 ELECTRON IMPACT DOUBLE EXCITATION OF HELIUM BY GLAUBER APPROXIMATION. Roy, K.; Sur, S. K.; Mukherjee, S. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 49: No. 2, 95-99(Feb 1975).

The (2s 2p)^{1}P double excitation cross section of helium by electron impact is investigated in the Glauber method. The standard eight dimensional integral for the amplitude obtained by the Glauber approximation is reduced to a one-dimensional integral which is numerically tractable. (auth)

Atomic Theory

Refer also to abstract 6335.

6308 (LBL-3917) COHERENCE IN MULTILEVEL SYSTEMS. Breiland, W. G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1975. Contract W-7405-ENG-48. 177p. Dep. NTIS $7.75.

Thesis.

Mathematical descriptions of an excited state multilevel system are developed to include progressively the effects of coherent coupling, feeding, decay and relaxation, and the expressions are illustrated with several pulse coherence experiments utilizing zero field optically detected magnetic resonance of excited triplet states. A new method is described in which the time development of the coherent components in a multilevel system is monitored by using an observable that can measure only relative populations between the levels. The method is illustrated. By treating a coherently driven excited state system as two levels in contact with a population reservoir, exact expressions are obtained for both transient and steady-state behavior in the presence of transverse and spin lattice relaxation, constant incoherent pumping, spontaneous emission between the two levels, and also decay back into the reservoir. The general mathematical development is applied specifically to zero field microwave phosphorescence double resonance. Experimental methods and apparatus are discussed in detail and results of optically detected transient mutations, spin echoes, and Fourier transform spectroscopy are presented. (26 figs, 220 refs) (auth)

6309 (UCCND-CSD-INF-58) HARTREE–FOCK CALCULATION OF VARIOUS EXCITED STATES OF NEUTRAL AND IONIZED IRON. Nestor, C. W. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Oct 1975. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

The Hartree–Fock computer program of Charlotte Froese Fischer was used to calculate configuration-averaged wave functions, binding energies, and radial expectation values for the ground states and the first few excited states of neutral and ionized iron, through helium-like Fe XXV ($1s^2$). A tabulation of the binding energies, a comparison of calculated and experimental ionization potentials, and a plot of the mean radius (r) vs effective nuclear charge for the outermost electrons in several of the excited states is presented. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstracts 5511, 6322, 6328, 6483, and 6655.

6310 (AD-8001387) INVESTIGATION OF COLD ANODES IN LOW PRESSURE ARCS WITH SUPERIMPOSED MAGNETIC FIELD. Schall, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (F. R. Germany)). 1974. 76p. (In German).

The behavior of the heat losses at the anode of a coaxial magnetoplasmadynamic accelerator with superimposed, longitudinal magnetic field is described and interpreted. According to the magnetic field-strength, the current density and the pressure in the anodic region, the experiments exhibit three different operation modes of the arc. They are distinguished by the magnitude of the anode fall and, owing to that, the heat losses, by the formation of current/voltage instabilities or by the existence of an arc spot. A different conduction mechanism in the transition region from the arc column to the anode is ascribed to each operation mode. (auth)

6311 SOME FEATURES OF THE PROPAGATION OF SOUND IN MOVING He II. Adamenko, I. N. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1520-1528(Apr 1975). (In Russian)

From calculations performed in the present paper it follows that propagation of waves in fluids possessing a nonlinear dependence of the force of friction on velocity are characterized by a number of peculiarities. An example of such a fluid is superfluid helium, in which friction is zero at velocities below a certain critical value and sharply increases at velocities exceeding the critical value. As a result, in moving helium the slowing-down force will be different for oscillations of the liquid in the direction of flow or in the opposite direction. It is shown that this leads, in particular, to a decrease of the time-mean velocity of liquid flow. This type of effect has previously been observed experimentally. According to the results of the present paper the relaxation times of a superfluid liquid can be assessed on the basis of the frequency dependence of the effect. (auth)

6312 THERMAL CONDITIONS AT THE GORTER-MELLINK COUNTERFLOW LIMIT BETWEEN 0.01 AND 3 BAR. Linnet, C.; Frederking, T. H. K. (Univ. of California, Los Angeles). J. Low Temp. Phys.; 21: No. 3/4, 447-462(Nov 1975).

Gorter–Mellink counterflow limits (at zero net mass flow) have been measured from 0.01 bar to about 3 bar in relatively wide ducts of rectangular (0.05 cm wide) and circular cross section (0.446 cm inner diameter). The observed limiting temperatures did not show metastable superheating of He II. Instead, they were controlled by the equilibrium state phase boundaries of the superfluid ^{4}He. Small departures from the related maximum temperature differences were in part caused by fluid acceleration and finite thermometer sizes, respectively. The measured limiting heat fluxes agree with the prediction based on the equilibrium state limits of the Gorter–Mellink temperature differences. (auth)

6313 TEXTURES AND SPIN CURRENTS IN THE B PHASE OF ^{3}He. Fomin, I. (Inst. of Theoretical Physics, Moscow); Vuorio, M. J. Low Temp. Phys.; 21: No. 3/4, 271-282(Nov 1975).

The effects of boundaries and magnetic fields on the textures of the B phase of liquid ^{3}He are considered. It is found that the liquid undergoes a change from an unbended into a bended state analogously to a second order phase transition. A measurement of the phase boundary would give the coefficients of the relevant free energies. Spin currents in bended states are given. It is shown, using minimization of the free energy, that spin conservation in the presence of supercurrents is satisfied by the internal Josephson effect. (1 figure) (auth)

6314 SUPERFLUID DENSITY OF ^{3}He MEASURED BY FOURTH SOUND. Kojima, H.; Paulson, D. N.; Wheatley, J. C. (Univ. of California, San Diego, La Jolla). Contract AT(04-3)-34. J. Low Temp. Phys.; 21: No. 3/4, 283-305(Nov 1975).

Superfluid density of ^{3}He has been measured using fourth sound in two superleaks: "confined," packed powder and "open," parallel channels. The superleak pore size has little effect on the superfluid density near the melting pressure, but it has surprisingly large effects at lower pressures. The open, parallel channel superleak results show an unexpected pressure dependence of "strong coupling" effects and an unexpectedly small superfluid density change at the B yields A transition. (10 figures) (auth)

6315 GAUGE THEORY OF SUPERFLUIDITY. Chela-Flores, J. (International Centre for Theoretical Physics, Trieste, Italy). J. Low Temp. Phys.; 21: No. 3/4, 307-319(Nov 1975).

A gauge theory of superfluidity in ^{4}He II is studied. An illustration of how the gauge principle leads to a meaningful low temperature theory is given. The field equations are then inferred, writing them down in their hydrodynamical form. Applications to some simple hydrodynamical problems are considered. (auth)

6316 VERY LOW TEMPERATURE PROPERTIES OF LIQUID HELIUM-3. Goldstein, L. (Los Alamos Scientific Lab., NM). J. Low Temp. Phys.; 21: No. 3/4, 321-345(Nov 1975).

Heat capacity and phase-boundary-line data on liquid ^{3}He in the few millikelvin temperature range obtained by Wheatley and his co-workers are analyzed within the framework of thermodynamics. The data favor the thermally anomalous disordered high temperature liquid phase to become of normal thermal behavior in its ordered B phase. The latter exhibits entropy decrease on isothermal compression, or its isobaric volume expansion coefficient is positive. At temperatures substantially below the phase-boundary temperatures, the ordered liquid might revert smoothly into a modification of anomalous thermal behavior, i.e., with entropy increase on isothermal compression. This alternation in the thermal behavior of the B phase, on experimental confirmation, could become helpful for a determination of the nature of its dominant thermal excitations in the indicated two temperature ranges, a situation reminiscent of the one existing in liquid ^{4}He II. Currently available magnetic susceptibility data raise the possibility, at very low temperatures, of further cooling liquid ^{3}He-B on adiabatic magnetization. (2 tables, 4 figures) (auth)

6317 VIRAL THEOREM FOR TRANSVERSE MHD FLOWS. Nath, V. I. (Univ., Sao Paulo, Brazil). J. Math. Anal. Appl.; 51: No. 1, 43-46(Jul 1975).

The virial theorem for transverse MHD flows is derived, and the necessary condition for the existence of stable equilibrium is obtained. This condition for monatomic gases implies a result which contradicts earlier work of Chandrasekhar and Fermi [Astrophys. J. 118, 116 (1953)]. (RWR)

6318 HYDROMAGNETIC FREE CONVECTION FLOW FROM A HORIZONTAL PLATE: NON-SIMILAR SOLUTIONS. Singh, P. Acta Phys. Acad. Sci. Hung.; 34: No. 1, 1-11(1973).

The boundary-layer equations of electrically conducting fluids over a semi-infinite horizontal flat plate due to the simultaneous action of buoyancy and applied vertical magnetic field are derived. The case when the surface temperature and the applied magnetic field are constant is studied in detail by Karman–Pohlhausen integral technique. Expressions for the shear stress and heat transfer at the plate are calculated for small Hartmann number and for any Prandtl number. (auth)

6319 FINITE-GEOMETRY EFFECTS, SUPERFLUID DENSITY, AND UNIVERSALITY IN ^{3}He–^{4}He MIXTURES NEAR THE SUPERFLUID TRANSITION. Thomlinson, W. C.; Ihas, G. G.; Pobell, F. (Inst. fuer Festkoerperforschung, Kernforschungsanlage Juelich, Ger.). Phys. Rev., B; 11: No. 11, 4292-4303(1 Jun 1975).

The amplitude and velocity of second sound near T/sub lambda/ were measured in ^{3}He–^{4}He mixtures with molar ^{3}He concentrations X equals 0.0000, 0.096, 0.204, 0.396, and 0.555. The sound was generated and detected in resonators equipped with superleak transducers with channel sizes d equals 0.2 mu m and d equals 0.6 mu m. The onset temperatures $T_0(X)$ for superfluidity were determined by observing the vanishing of the second-sound amplitude at temperatures below T/sub lambda/(X). The reduced shift, epsilon$_0$ equals $1 - T_0(X)/T/\text{sub lambda}/(X)$, of the onset temperature T_0 increases by about a factor of 6 for X equals 0 to X equals 0.4. The critical exponents in the equations epsilon$_0$ equals (d/d*)$^-$/sup lambda/' and 1 equals 1*epsilon$^-$/sup nu/' are independent of X to within 3 percent (l is the onset length for superfluidity). In addition, the quantity l rho/sub s//T is found to be independent of concentration in agreement with theoretical predictions. For the superfluid fraction, rho/sub s//rho equals k epsilon/sup zeta/, it is found that the exponent zeta is nearly concentration independent for X equals 0.0 to 0.4, whereas the amplitude k decreases by almost an order of magnitude. (12 figures) (auth)

6320 MOMENTUM DISTRIBUTION FOR TWO MANY-BOSON SYSTEMS. Grest, G. S. (Rutgers-The State Univ., New Brunswick, NJ). Phys. Rev., B; 11: No. 11, 4730-4733(1 Jun 1975).

The momentum distribution n (k) and condensate fraction N_0/N for liquid helium and for a charged Bose gas are evaluated in perturbation theory through second order in 1/root N. For liquid helium at normal vapor pressure, to this order in perturbation theory, unphysical, negative values are obtained for n (k). This result is discussed in detail. (auth)

6321 SURFACE TENSION OF ^{4}He BELOW 0.35 K. Edwards, D. O.; Fatouros, P. P.; Ihas, G. G.; Mrozinski, P.; Shen, S. Y. (Ohio State Univ., Columbus). Phys. Rev., B; 11: No. 11, 4734-4735(1 Jun 1975).

The surface tension (sigma) of liquid ^{4}He purified to contain 0.4 +- 0.2 parts per 10^9 ^{3}He was measured as a function of temperature in the range 0.02 less than T less than 0.35^{0}K. It is found that the data agree with Atkins's ripplon theory for the temperature dependence of sigma(T). The measurements complement earlier work in the temperature range 0.02^{0}K less than T less than T/sub lambda/ in which the surface tension below approximately 0.3^{0}K was affected by the natural ^{3}He impurities. (auth)

6322 NUMERICAL SOLUTION OF LANDQUIST EQUATIONS OF MAGNETOHYDRODYNAMICS. Johnston, R. L.; Pal, S. K. Math. Comput.; 28: No. 125, 33-44(Jan 1974).

A method of solution for a hyperbolic system of partial differential equations is presented. The solution is obtained by numerically integrating along a selected bicharacteristic, and the difference in solution obtained by using a different bicharacteristic is on the order of the truncation error. The requirements for stability are presented. The method is used to treat two sample problems of wave propagation in an inviscid electrical conducting adiabatic fluid in the presence of electric and magnetic fields. One solution is for the three-dimensional propagation of small pressure disturbance in a compressible fluid, and the other is for cylindrical waves which simulate the sudden release of a compressed mass of conducting gas in the presence of a magnetic field, i.e., a stellar explosion. In each case, the exact solution and numerical solution of the linear equation, and the mumerical solution of the nonlinear equations are presented. The paper is clearly written, is adequately referenced, and should be of interest to those attempting solutions of multidimensional nonlinear hyperbolic systems of partial differential equations. (Appl. Mech. Rev.)

6323 HEAT TRANSFER BETWEEN SUB-MICRON SILVER POWDER AND DILUTE ^{3}He-^{4}He SOLUTIONS. Radebaugh, R.; Siegwarth, J. D.; Holste, J. C. (National Bureau of Standards, Boulder, CO). pp 242-245 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The thermal resistance between copper cells lined with silver powder of 0.1-0.2 μm diameter and a dilute stream of ^{3}He in ^{4}He was measured between 15 and 250 mK. The results show that this powder can give an order of magnitude lower thermal resistance at 15 mK than an equal volume of copper powder of 1.8 μm diameter. The scientific and engineering significance of such a low resistance in a small volume is discussed. At the higher temperatures R is proportional to T^{-1}, which can be explained by a liquid thermal resistance and a resistance at the joint between the powder and the cell walls. (4 figures) (auth)

6324 KAPITZA THERMAL RESISTANCE OF METAL-LIQUID ^{3}He INTERFACE AT VERY LOW TEMPERATURES. Kubota, M.; Fujii, Y.; Kodama, T.; Morii, Y.; Shigi, T. (Osaka City Univ.). pp 246-249 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Kapitza resistivity R of the indium-liquid ^{3}He interface has been measured from 20 mK to 0.3 K in the superconducting state and also in the normal state of indium by using thin indium films plated on copper blocks. Between 30 mK and 120 mK the ratio of Kapitza resistivities in the superconducting state and in the normal state of indium was about 1.3 in consistence with the calculation of Challis and Cheeke in the first series of measurements, but the experimental values of RT^3 were smaller than the theoretical ones by a factor of 4. At both sides of this temperature region the value of RT^3 decreased rather rapidly. (auth)

6325 HEAT TRANSFER FROM HORIZONTAL CYLINDER TO SUBCOOLED LIQUID HELIUM. Tsuruga, H.; Endoh, K. (Hokkaido Univ., Sapporo). pp 262-264 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Experiments were made on the heat transfer in subcooled liquid helium I and II from a horizontal copper cylinder which was 2.5 cm in diameter and 5 cm in length. The results for helium I indicated some difference between subcooled and saturated helium. The heat flux in subcooled helium was larger than that of saturated helium in the nucleate-boiling region. In the free-convection region, the heat flux of subcooled helium was smaller than that of saturated helium. In the experiments for helium II, it was found that the difference of heat transfer rate between subcooled and saturated helium did not appear significantly. (5 figures) (auth)

6326 BROKEN SYMMETRIES AND EXCITATION MODES IN LIQUID HELIUM II. Ahmed, M. (Univ. of Kashmir, Srinagar, India). Indian J. Phys.; 49: No. 2, 158-161(Feb 1975).

At about absolute zero, liquid ^{4}He lies in its ground state consisting of bare particles and the dynamical equations obey certain symmetries. The field interaction changes the behavior of this system to physical or quasi-particle states and the system becomes superfluid, where the above symmetry becomes broken. The most elegant way of describing this difference is to establish relationships, in the form of canonical commutation relations, which take different form when broken symmetries are said to have taken place. Here an important role is played by massless particles—the phonons, which represent the Goldstone particles. These Bosons are described with vanishing momentum in terms of the linear homogeneous equation valid for a massless stable physical field. (RWR)

6327 CHARACTER OF EQUILIBRIUM OF A HEAVY VISCOUS INCOMPRESSIBLE, FINITELY CONDUCTING, ROTATING FLUID IN THE PRESENCE OF A VERTICAL MAGNETIC FIELD. Sharma, B. M. (Univ. of Udaipur, Rajasthan, India); Ariel, P. D. Indian J. Phys.; 49: No. 2, 100-116(Feb 1975).

The character of equilibrium of heavy, viscous, incompressible, finitely conducting, rotating fluid in the presence of a magnetic field along the direction of the gravitational field was investigated. It was shown that the solution is characterized by a variational principle. Based on the existence of a variational principle, an approximate solution was derived for the case of a fluid having exponentially varying density in the vertical direction. Due to finite conductivity of the fluid it is found that a potentially stable or unstable configuration retains its character. The growth rate of disturbance was obtained corresponding to long and short wave lengths. It is shown that for short wave lengths the growth rate of disturbance is independent of the magnitude of rotation and finite electrical conductivity. Finally, the special case in which the waves arise in the absence of buoyancy forces was treated. (4 figures) (auth)

6328 RAYLEIGH-TAYLOR INSTABILITY OF POLARIZABLE AND MAGNETIZABLE LIQUIDS IN A VARIABLE ELECTROMAGNETIC FIELD. Buchin, V. A.; Tsypkin, A. G. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 219: No. 5, 1085-1088 (11 Dec 1974). (In Russian).

A set of equations is presented describing the behavior of the interface of two homogeneous incompressible liquids in an electromagnetic field. The unperturbed state of the liquids is the rest state, and small deviations from the equilibrium state are considered. The behavior of the interface of the two liquids is controlled by means of an external electromagnetic field by using the difference in the dielectric and magnetic permeabilities of the liquids. By means of the external magnetic field the perturbations of the interface of the two liquids can be made stable. (SJR)

6329 POOL BOILING HEAT TRANSFER TO LIQUID HELIUM AND LIQUID NITROGEN IN A NEARLY ZERO GRAVITY ENVIRONMENT. Edeskuty, F. J.; Williamson, K. D.; Taylor, J. F. (Los Alamos Scientific Lab., NM). pp 258-261 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A rocket-borne experiment was designed to obtain steady data on nucleate boiling heat transfer to liquid helium and liquid nitrogen in a nearly zero gravity environment. The experiment was successfully launched and was maintained at nearly zero gravity for five and one-half minutes. Under this condition the peak nucleate heat flux was reduced below the 1 g value. The results obtained are presented. (3 figures, 1 table) (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 6386.

Electromagnetic

6330 (COO--2232A) DIRECT ELECTRONS AT THE CERN ISR. II. A Study of the Transverse Momentum Dependence Above 0.6 GeV/c. Buesser, F. W.; Camilleri, L.; Di Lella, L. (Rockefeller Univ., New York (USA)). 1975. 13p. (CONF-750855--11). Dep. NTIS $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

The previously reported observation of direct electrons produced in proton-proton collisions at the CERN ISR was extended to transverse momenta, p*/sub T/, as low as 0.6 GeV/c. The ratio of electron to pion cross sections seems to rise as p*/sub T/ is decreased. It increases by at most a factor of 2 between p*/sub T/ of 2 and 0.6 GeV/c. Results on the s-dependence of this ratio and on correlated charged particles are presented for p*/sub T/ greater than or equal to 1 GeV/c in another work. (auth)

6331 (COO--2232A-26) DIRECT ELECTRONS AT THE CERN ISR. I. A Study of the s-Dependence and of Correlated Charged Particles. Buesser, F. W.; Camilleri, L.; Di Lella, L. (Rockefeller Univ., New York (USA)). 1975. 18p. (CONF-750855--8). Dep. NTIS $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

A previously reported observation of electrons produced in proton-proton collisions at the CERN ISR was extended to 5 different center-of-mass energies (root s equals 23.5, 30.6, 44.8, 52.7 and 62.4 GeV). The apparatus detected electrons with transverse momenta, p*/sub T/, greater than 1.0 GeV/c. The ratio of the electron to pion cross sections in the kinematic region is approximately 10^{-4}. The momentum spectrum and particle composition of particles emitted with DELTA phi approximately 180^0 relative to the electrons are found to be similar to those emitted with pions. Results at p*/sub T/ less than 1 GeV/c are presented in another work. (auth)

6332 (COO--2232A-28) OBSERVATION OF J(3.1) PRODUCTION IN PROTON--PROTON COLLISIONS AT THE CERN ISR. Buesser, F. W.; Camilleri, L.; Di Lella, L. (Rockefeller Univ., New York (USA)). 1975. 15p. (CONF-750855--10). Dep. NTIS $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

In an experiment performed at the CERN Intersecting Storage Rings (ISR), 11 e^+e^- pairs of high invariant mass value (greater than 2.5 GeV/c^2) were observed. Of these events, 9 can be interpreted as arising from the reaction p + p yields J(3.1) + anything. The cross section for this reaction is estimated and compared with the result obtained at lower center-of-mass energies. (auth)

6333 (LAL-1282) PION FORM FACTOR IN THE TIME-LIKE REGION FROM $e^+e^- \rightarrow \pi^+\pi^-$ NEAR THRESHOLD. Wuenzer, A.; Rumpf, F.; Bertrand, J. L. (Ecole Normale Superieure, 91--Orsay (France). Lab. de l'Accelerateur Lineaire). Oct 1975. 8p. (CONF-750855--12). Dep. NTIS (US Sales Only) $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

A first measurement of the $e^+e^- \rightarrow \pi^+\pi^-$ reaction close to threshold is reported. The result obtained for F_π is in very good agreement with the "Gounaris--Sakurai" extrapolation of the ρ-ω results. (auth)

6334 (LBL-4281) QUANTUM ELECTRODYNAMICS WITH THE SPEAR MAGNETIC DETECTOR. Zipse, J. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-ENG-48. 163p. Dep. NTIS $7.75.

Thesis.

One makes a study of quantum electrodynamic processes which are present at the SPEAR colliding beam magnetic detector. We begin by describing the experiment performed by the SLAC-LBL collaboration and the results concerning the strong interaction. Then the interactions e^+e^- yields e^+e^- and e^+e^- yields mu$^+$mu$^-$ are considered along with their third-order radiative corrections. These events, previously used to determine new limits for cutoff parameters in QED breakdown models, are further studied to show that the full distribution in coplanarity angle fits the theoretical prediction well. The major focus is on the fourth order two-photon process, e^+e^- yields $e^+e^-A^+A^-$, which only recently has been realized to be significant in such experiments. Cross sections are derived and calculated exactly for this process and the results compared to a Weizacker-Williams equivalent photon calculation. The two-photon data are then isolated and fit to the calculation. A special experiment was done where the small-angle scattered electron or positron is "tagged" along with particles in the main detector. Cross sections and coplanarity distributions are measured and compared to calculation. Through these studies, one feels confident that one understand the nature of the two-photon process in the detector. One further explores the hadronic physics of the two-photon process, e^+e^- yields e^+e^- hadrons, measuring pion cross sections, searching for resonances, and discussing future experiments. (auth)

6335 HIGH ELECTRIC FIELD EXPERIMENTS ON GROUND STATE GALLIUM ATOMS AND AN ATTEMPT TO REDUCE THE UPPER LIMIT ON THE ELECTRIC DIPOLE MOMENT OF THE ELECTRON. Rosenthal, S. J. Waltham, MA; Brandeis Univ. (1975). 80p. University Microfilms Order No. 75-15,123.

Thesis (Ph. D.).

An atomic beam magnetic resonance technique has been used to measure the differential Stark splitting between "flop-in" Zeeman levels in the ground state hyperfine structure of ^{69}Ga and ^{71}Ga. Precision measurements of the shift were made at several electrical fields up to 200 kv/cm, and various rf power levels. A significant rf dependence was observed and it was necessary to extrapolate to zero rf power to obtain the final result. The shift was determined to be 500(16) x 10^{-10} Hz/(v/cm)^2, including systematic uncertainties in the electric field value and the filling factor. This can be interpreted as a tensor polarizability of 667(21) x 10^{-10} Hz/(v/cm)^2 or 2,700(,084) x 10^{-4} a_0^3. The shift increases the magnetic splitting between the M/sub F/ equals -1 and the M/sub F/ equals -2 sublevels. The theoretical and experimental results are compared and found to agree well, to within the stated errors. The results of an attempt to reduce the upper limit to the electric dipole moment of the electron are also presented. The method differs from earlier work in that heated glass electric field plates capable of sustaining 500 kv/cm were used. An instrumental effect involving the intrinsic time constant of heated glass electrodes was discovered, which limited our final results to (,8 +- 8,1) x 10^{-21} cm/e for the EDM of the cesium atom, and (,7 +- 6,8) x 10^{-23} cm/e for the electron, as compared with the best previous result of 3 x 10^{-24} cm/e for the electron performed by Weisskopf. (auth)

6336 PHOTON--PHOTON INTERACTIONS BY THE e^+e^- FRASCATI STORAGE RING. Barbiellini, G.; Ceradini, F.; D'Angelo, S.; Grilli, M.; Orito, S.; Paoluzi, L.; Santonico, R.; Tsuru, T.; Valente, V.; Visentin, V. (Univ., Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Nat.; 55: No. 2, 249-259 (1973). (In Italian).

A tagging system was proposed in order to identify photon--photon processes on an event by event basis. Results for cross sections obtained using this technique are reported for the process $e^+e^- \rightarrow 2e^+2e^-$ and $e^+e^- \rightarrow e^+e^-\mu^+\mu^-$ at incident energies around 800 MeV. (JFP)

6337 EXPERIMENT TO MEASURE THE RELATIVE VELOCITIES OF GAMMA RAYS AND ELECTRONS AT 15 GeV. Rothbart, G. B. Stanford, CA; Standord Univ. (1975). 94p. University Microfilms Order No. 75-21,895.

Thesis (Ph. D.).

An experiment performed at the Stanford Linear Accelerator Center (SLAC) to search for difference in the velocity of propagation of 15-GeV electromagnetic radiation and electrons in the energy range of 15 to 20 GeV. Using the time-of-flight concept, high energy electrons and gamma rays produced by their bremsstrahlung at a point within the accelerator traverse a flight path of 1015 meters. In one case, electrons drift unaccelerated; in another case electrons are accelerated over the remaining 815 meters of the accelerator structure to 20.5 GeV and then drift the last 200 meters of the accelerator structure to 20.5 GeV and then drift the last 200 meters of flight path. By means of an adaptation of the secondary beamline associated with the 82" bubble chamber and a novel application of an RF separator, the relative arrival times of these particles are measured to less than 1 picosecond. A relative velocity difference larger than 5 parts in 10^{10} would imply a departure from the predictions of special relativity and the possible existence of a "fundamental length." However, no anomalous

difference in the velocity of light and electrons was observed to within a few parts in 10^{1}. (Diss. Abstr. Int., B)

Weak

6338 (COO-1428-428) INCLUSIVE-LOOK AT nu p AND nu p CHARGED-CURRENT REACTIONS BELOW 6 GeV. Barish, S. J.; Derrick, M.; Dombeck, T. (Argonne National Lab., Ill. USA); Purdue Univ., Lafayette, Ind. (USA)). 1975. 29p. (CONF-750855-4). Dep. NTIS $5.00.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

Preliminary results are presented from a study of inclusive charged-current neutrino interactions from threshold to 6 GeV on a pure proton or deuteron target by summing exclusive reactions at energies up to 6 GeV. Both nu n and nu p total cross sections are found to rise with energy, and the neutron-to-proton cross section ratio is measured to be 1.40 +- 0.31 for E/sub nu/ greater than 2 GeV. The Y and X distributions and the cross sections for quasi-elastic scattering, excitation functions, single pi, 2pi, and 3pi production are discussed. It is found that the precocious scaling observed previously holds equally for the individual nu-proton and nu-neutron interactions. (JFP)

6339 CHARACTERISTICS OF PRIMARY COSMIC RAYS AND ULTRA-HIGH ENERGY INTERACTIONS FROM MULTIPLE MUON DATA. Goned, A. (Univ. of Durham, Eng.; Stewart, T. R.; Wolfendale, A. W.; Wdowczyk, J. Nuovo Cim.; 29A: No. 3, 317-334(1 Oct 1975).

The calculations given in the preceding paper by Goned are used to predict the frequencies of energetic muons in the Utah underground experiment. A reasonable fit to experiment arises when a "normal composition" type primary spectrum with differential exponent equal to 2.75 is taken together with a scaling model for high energy interactions. Difficulties arise however when these assumptions are used to predict other characteristics of extensive air showers. (auth)

6340 MUONS PRODUCED BY ATMOSPHERIC NEUTRINOS FROM THE VIEWPOINT OF THE PHOTON NEUTRINO WEAK COUPLING THEORY. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta); Chattopadhyay, M. K. Acta Phys. Pol., Ser. B; B6: No. 5, 673-681(1975).

The experimental rate of muons produced deep underground by neutrinos and the atmospheric-neutrino spectrum as determined from cosmic ray muon data was analyzed on the basis of the photon-neutrino weak coupling theory. It is shown that theory of weak interactions based on the photon-neutrino weak coupling and dynamical origin of charge, which predicts that the cross section falls off with energy in the high energy region beyond the threshold energy for large mass resonances, is not in contradiction with the observed rate of muons produced by atmospheric neutrinos. (auth)

Strong (Baryon-induced)

6341 (CONF-750858--6) MEASUREMENTS OF TOTAL CROSS SECTIONS BETWEEN 23 AND 280 GeV/c. Koehler, P.F.M. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 1975. 4p. Dep. NTIS $4.50.

From meeting of the ASP division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

The high precision measurements of the total cross sections for pi/sup +-/, K/sup +-/, p, and anti p scattering from H_2 and D_2 were continued with an extension of the energy range from 23 to 280 GeV/c. (JFP)

6342 (COO--2232A-27) HIGH TRANSVERSE MOMENTUM PHENOMENA INVOLVING pi AND eta MESONS. Buesser, F.W.; Camilleri, L.; Di Lella, L.; Di Lella, L. (Rockefeller Univ., New York (USA)). 1975. 32p. (CONF-750855--9). Dep. NTIS $5.00.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

The inclusive production of pi and eta mesons at theta/sub cm/ equals 90^{0} was measured for proton-proton collisions at five center-of-mass energies between 23.5 and 62.4 GeV. The momentum correlation of charged particles emitted together with a large transverse momentum pi was also studied using two magnetic spectrometers each centered at theta/sub cm/ equals 90^{0}. (auth)

6343 (ISN-T-75-01) MEASUREMENT OF SPIN CORRELATION COEFFICIENTS Cxx, Cyy, AND S IN DEUTERON-PROTON ELASTIC SCATTERING AT LOW ENERGY. Chauvin, J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). 28 Feb 1975. 225p. (In French). Dep. NTIS (US Sales Only) $8.75.

Thesis.

It is found that the N-N potentials in the Faddeev equations reproduce nucleon-deuteron elastic scattering considered as realistic. Cross sections and spin correlation coefficients are considered. (JFP)

6344 (JINR-P1-8926) SLOW PARTICLE SPECTRUM IN THE INTERACTION OF 70 GeV/c PROTONS AND 9.4 GeV/c DEUTERONS WITH C, N, O, Ag, Br NUCLEI. Dalkhazhav, N.; Rafiev, I.; Salomov, Dzh. A.; Tolstov, K. D.; Khoshmukhamedov, R. A.; Shabratova, G. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

Unique separation of interactions with the group of light nuclei (C, N, O) and Ag, Br nuclei has been performed using the nuclear photoemulsions of an ordinary structure and saturated with light nuclei. The energy and charge spectra of slow particles have been determined. The whole complex of data inderlines nonequilibrium character of processes generating the slow particle spectrum. (6 figures, 2 tables) (auth)

6345 (LPNHEX-T-74-3) pp ELASTIC SCATTERING IN THE BACKWARD HEMISPHERE AT LOW MOMENTUM (BETWEEN 175 AND 750 MeV/c IN THE LABORATORY SYSTEM). Indications in Favor of the Appearance of the "S Meson" with $J^{PC} = 4^{++}$. Laloum, M.. (Paris-11 Univ., 91-Orsay (France)). 22 May 1974. 160p. (In French). Dep. NTIS (US Sales Only) $7.75.

Thesis.

Cross sections are studied for the reaction pp → pp in the backward hemisphere. Quantum numbers for the S meson are found to be $J^{P}I^{G} = 4^{+}1^{-}$. (JFP)

6346 SECONDARY PARTICLES IN STARS PRODUCED BY COSMIC-RAY NUCLEI WITH ENERGIES 0.1 TO 1 GeV/NUCLEON. Bogdanov, S. D.; Ostroumov, V. I.; Radchenko, I. S. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 22: No. 1, 132-135(Jul 1975). (In Russian)

Stars in an emulsion chamber bonbarded by cosmic-ray nuclei with energies 0.1 to 1 GeV/nucleon are investigated. Data on the multiplicity, angular and energy distributions of protons and α particles are obtained. (auth)

6347 METHOD OF THE FINE INTERNAL TARGET FOR THE INVESTIGATION OF ELASTIC pp- AND pd-SCATTERING. Hristov, L.; Zlatanov, Z. God. Vissh. Tekh. Uchebni. Zaved., Fiz.; 8: No. 1, 117-122(1971). (In Russian)

It is shown that with the aid of the measurement of the paths of the scattered particles in the output in detectors (photoemulsion chambers) it is possible to determine the position of the target in the direction of the primary proton beam, with respect to the detectors, with precision of about ±1 mm as well as the energy of the primary protons, with precision of about ±0.3 MeV within a given energy interval. (auth)

6348 ELASTIC PROTON-NEUTRON SCATTERING AT ENERGY 70 GeV. Zajacki, V. God. Vissh. Tekh. Uchebni. Zaved., Fiz.; 8: No. 2, 31-38(1971). (In Russian)

The results of the analysis of the differential cross sections of pn elastic scattering at 70 GeV are presented. The slope parameter for the diffraction cone and the ratio of the real part amplitude to imaginary of pn elastic scattering at the value of the four-momentum square are determined. (auth)

6349 SLOPE PARAMETER OF THE DIFFRACTION CONE OF THE ELASTIC pd SCATTERING AT ENERGY 30 GeV. Zajacki, V.; Zlatanov, Z.; Jovcev, K.; Hristov, L. God. Vissh. Tekh. Uchebni. Zaved., Fiz.; 8: No. 2, 23-30(1971). (In Russian)

The results are presented of measurements of the slope parameter for diffraction cone of pd elastic scattering. (auth)

6350 SPECTRA OF COSMIC PIONS AND NUCLEONS AT LOW AND HIGH GEOMAGNETIC LATITUDES AT THE TOP OF THE ATMOSPHERE. Bhattacharyya, D. P.; Mukherjee, M.; Basu, D. (Indian Association for the Cultivation of Science, Calcutta). Ann. Phys. (Leipzig); 32: No. 3, 161-165(Mar 1975).

The spectra of cosmic pions and nucleons at an atmospheric depth of 100 g cm^{-2} were derived from sea level muon spectra at low and high latitudes. The derived spectra of pions and nucleons at low and high latitudes follow the relations $N(E_\pi)dE_\pi = 0.23\ E_\pi^{-2.68}dE_\pi$ and $N(E_p)\ dE_p = 2.98\ E_p^{-2.68}dE_p$ per cm^2 sec str GeV in the energy range 15 to 1200 GeV. Below 15 GeV it is found that the exponent of the energy spectrum is very much dependent upon the incident energy and latitude of the location. The major difference between low and high latitude pion spectra can be explained in terms of geomagnetic effects. (auth)

6351 TOP ENERGY HADRONIC COLLISIONS USING COSMIC RAYS. Jones, L. W. (Univ. of Michigan, Ann Arbor). pp 785-826 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750--.

Some high points of knowledge of elementary particles as gained from cosmic ray experiments below 1 TeV which complement the new ISR data are discussed, and then experiments above a few TeV are considered where tentative indications of qualitatively new phenomena are seen. The Echo Lake experiment, cloud chamber experiments, produced particles, cross sections, gamma families, the Utah effect, extensive air showers, scaling, quarks, and heavier nuclei. (JFP)

6352 CASCADE RESONANCE PRODUCTION IN YK ANTI K FINAL STATES AT 2.37 GeV/c. Tompkins, J. M. Medford, MA; Tufts Univ. (1974). 177p. University Microfilms Order No. 75-21, 226.

Thesis (Ph. D.).

A 17-eV/mub exposure of K^- mesons incident upon deuterium at a momentum of 2.87 GeV/c was examined for evidence of XI* production in YK anti K final states. No significant signals are observed, although the final state LAMBDA K^-K^0 shows promise for the study of XI*(1820). Cross sections are measurbd for all constrained YK anti K channels. (Diss. Abstr. Int., B)

6353 COHERENT PRODUCTION REACTION p + A yields p + pi^0 + A. Scott, H. A. Rochester, NY; Univ. of Rochester (1975). 182p. University Microfilms Order No. 75-22,776.

Thesis (Ph. D.).

The reaction p + A - A + p + pi^0 produced by the collision of high momentum protons (22.7 GeV/c) incident upon complex nuclear targets was studied. Targets of C, Al, Cu, Ag and Pb were employed. The measurements were executed using a counter-spark chamber spectrometer system in a secondary beam line of the Brookhaven National Laboratory 33 GeV Accelerator. The coherent reaction, whereby the recoiling nucleus remains in the ground state, was isolated from the data sample primarily by invoking appropriate cuts in the momentum transfer variable. Two different reaction mechanisms were observed to occur: the processes of diffraction dissociation and coulombic dissociation. A detailed comparison of the coulombic dissociation data and the related known photoproduction process gamma + p yields p + pi^0 is presented, and a unique confirmation of the Coulombic process with absorption corrections is provided. Mass spectra, diffraction patterns, A dependence and angular distributions for the diffractive dissociation data are presented. (Diss. Abstr. Int., B)

6354 NEW LOCAL AXIOMATIC RESTRICTIONS FOR THE DIFFERENTIAL CROSS-SECTIONS. Lomsadze, Yu. M.; Kelemen, V. I. (Inst. of Theoretical Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 3, 247-251(Mar 1975). (In Ukrainian).

Two types of new local axiomatic restrictions are obtained for the differential πN forescattering cross sections. The restrictions of the first type possess regulated high energy sensitivity, while the second type ones are practically insensitive to high energy behavior of these differential cross sections. (auth)

6355 DEPENDENCE OF MULTIPLICITY OF PARTICLES PRODUCED IN PROTON–NUCLEUS INTERACTIONS AT HIGH ENERGIES ON THE MASS NUMBER OF TARGET. Babecki, J. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., Ser. B; B6: No. 3, 443-451(1975).

The mean values $\langle N_h \rangle$ and the mean multiplicities $\langle n_s \rangle$ in the interactions of high-energy protons with two groups of nuclei (CNO and AgBr) were evaluated from the experimental emulsion data at different energies. The experimental data of $\langle n_s \rangle$ are well fitted by the dependence: $\langle n_s \rangle = C + DA^{\frac{1}{3}}$ (A—the mass number of target), which seems to be universal in a very wide interval of primary energies from 6.2 to thousands of GeV. A comparison of the experimental results with the predictions of theoretical calculations was made. (auth)

6356 ANGULAR DISTRIBUTION OF SECONDARY PARTICLES IN pN INTERACTIONS AND COHERENT DIFFRACTION PRODUCTION OF PIONS BY PROTONS WITH A MOMENTUM OF 200 GeV/sec. Azimov, S. A.; Abduzhamilov, Sh.; Aliev, M.; Askarkhodzhaeva, Kh. M.; Gadzhieva, S. I.; Dzhuraev, M.; Kasymova, N.; Chudakov, V. M. (Physical-Technical Univ., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 3, 22-24(1975). (In Russian).

The width and azimuthal angular distribution of secondary charged particles and the coherent diffraction production of pions by protons at 200 GeV/sec were studied on nuclear emulsions irradiation at the Argonne accelerator. The mean free path for the inelastic interaction of protons was 36.2 cm, in good agreement with previous results. The distribution of pure stars according to multiplicity, the distribution of pure stars with different numbers of secondary particles with respect to the coherent pion production, and the dependence of the cross section of the coherent reaction on the proton momentum were determined. (JSR)

Strong (Meson-induced)

Refer also to abstract 6476.

6357 (CONF-750858--3) SEARCH FOR CHARM IN 250 GeV/c pi$^-$p INTERACTIONS. Bogert, D.; Hanft, R.; Albright, J. R. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Oct 1975. 12p. Dep. NTIS $4.50.

From meeting of the ASP division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

A study was made of the reaction pi$^-$ + p at 250 GeV/c in order to search for charmed particles. Cross sections, effective mass distributions, and an upper limit for each decay mode were found. However, no evidence was found for charmed particles. (JFP)

6358 (COO-1428-425) ENERGY DEPENDENCE OF PI$^-$ ELASTIC SCATTERING AT COS THETA/sub CM/ APPROXIMATELY -.96. Dixon, R. L.; Fletcher, J. M.; Garfinkel, A. F.; Loeffler, F. J.; Madrak, S.; Shibata, E. I.; Stanfield, K. C.; Tang, Y. W.; Hoffman, E. W. (Purdue Univ., Lafayette, Ind. (USA); Argonne National Lab., Ill. (USA)). 1975. 3p. (CONF-750858-8). Dep. NTIS $4.50.

From meeting of the ASP division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

The differential cross section was measured for pi$^-$p yields p pi$^-$ near the backward direction for incident laboratory momenta between 3.0 and 5.5 GeV/c. Preliminary results are reported at cos theta* approximately -0.96. Evidence is seen for DELTA-(2850) and DELTA(3230); however, no evidence was found for the narrow resonance at P/sub lab/ approximately 5.12 GeV/c reported by Kormanyos et al. (auth)

6359 (COO-1545-170) HIGH STATISTICS STUDY OF omega^0 PRODUCTION AT 6 GeV/c. Shaevitz, M. H. (Oklahoma State Univ., Stillwater (USA)). 1975. 166p. Dep. NTIS $7.75.

Thesis.

The spin-projected cross sections for omega^0 production at 6 GeV/c were measured in a counter-spark chamber experiment at the Zero Gradient Synchrotron of Argonne National Laboratory. Results are presented for a sample of 25,000 omega^0 events, and critical tests are shown for any residual background. The reaction is dominated by the s-channel natural-parity helicity one projection (rho_{11} + rho/sub 1-1) d sigma/dt which shows a turnover in the forward direction and no strong dip at t equals 0.6 (GeV/c)^2. The unnatural-parity helicity-zero cross section rho_{00} d sigma/dt shows no forward turnover suggesting a sizeable helicity-nonflip contribution. Comparisons are made with the predictions of a Regge exchange model with absorptive corrections. (auth)

6360 (DESY-75/32) RESULTS ON TWO-BODY DECAYS OF THE (3100)-RESONANCE. Criegee, L.; Dehne, H. C.; Fox, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1975. 10p. (CONF-750855-2). Dep. NTIS (US Sales Only) $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

The two-body decay modes J(3100) → $\mu^+\mu^-$ and → $\bar{p}p$ were observed with the magnetic detector PLUTO at the storage ring DORIS. One obtains the relative branching ratios $\Gamma_{ee}\Gamma_{\mu\mu}/\Gamma = 0.32 \pm 0.08$ keV and $\Gamma_{\bar{p}p}/\Gamma_{\mu\mu} = 0.051 \pm 0.02$. In addition the μ pair forward-backward asymmetry $F - B/F + B = 0.06 \pm 0.07$ in the angular range $0.6 \leq |\cos\theta| \leq 0.85$, indicating the absence of a dominant $V \pm A$ term in the decay process. (auth)

6361 (FRNC-TH-530) INTERACTION K$^-$p AT 2 GeV/c. Baccari, B. (Paris-2 Univ., 75 (France)). 30 Sep 1971. 72p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis.

Total and differential cross sections were studied for $\pi^\pm$, $\Sigma^\pm$, K^0N, and $\Lambda\pi^0$ channels of the reaction K$^-$ p at 1.95 to 2.35 GeV/c. (JFP)

6362 (FRNC-TH-5321) STUDY OF $K^+p \to K^{+0}\ p\ \pi^{0+}$ BETWEEN 2.1 AND 2.7 GeV/c. Brunet, J. M. (Paris-2 Univ., 75 (France)). 22 Jun 1971. 103p. (In French). Dep. NTIS (US Sales Only) $6.50.

Thesis.

A study is made of the reactions $K^+ + p \to K\pi N$ at four incident momenta of 2.11, 2.31, 2.53, and 2.72 GeV/c, and especially the processes $K^+p \to K^0\pi^+p$ and $K^+p \to K^+\pi^0p$ in which the resonances K(892) and $\Delta^+(1236)$ are produced abundantly. The study of the production of these resonances is made in terms of a simple Regge model. It allows, with the inclusion of other experimental results at neighboring momenta, the establishment of vector meson exchange dominance. This result is confirmed by the study of resonance decay angular distributions and the determination of corresponding density matrix elements. The relations predicted

by the quark model for these reactions are likewise tested. (tr-auth)

6363 (JINR-E1-9084) EMISSION OF π^0 AND ETA^0 MESONS IN π^+ + Xe INTERACTIONS AT 2.34 GeV/c AND THE PROBLEM OF THE EXISTENCE OF π MESONS INSIDE THE NUCLEUS. Slowinski, B.; Sturgalski, Z.; Sredniawa, B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 22p. Dep. NTIS (US Sales Only) $5.00.

Results are presented for the investigation of the angular and energy distribution of π^0 and eta^0 mesons from the reaction π^+ + Xe at 2.34 GeV/c in which no more than four charged secondary particles and two gamma quanta are emitted. A considerable collimation of the emission of π^0 meson was found in the region of small values of emission angles. Such a collimation corresponds to the π^0 production in collisions of incident π^+ mesons with intranuclear particles possessing masses of the order of 100 MeV. (8 figures, 2 tables) (auth)

6364 (JINR-P1-9093) INCLUSIVE REACTIONS WITH STRANGE PARTICLES IN π^--p INTERACTIONS AT 5 GeV/c. Glagolev, V. V.; Pestova, G. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The inclusive reactions $\pi^-p \to \Lambda$ + anything, $\pi^-p \to \Sigma^\pm$ + anything, $\pi^-p \to K^\pm$ + anything, and $\pi^-p \to K^0_1$ + anything were studied at an initial π^- meson momentum of 5 GeV/c and the results were reported. The momentum and angular distributions and the average characteristics of the productions of $\Sigma^\pm$ and Λ hyperons and of $K^\pm$ and K^0_1 mesons in these reactions were reported. (tr-auth)

6365 (ORO-3509-12) ELEMENTARY PARTICLE PHYSICS AT THE FLORIDA STATE UNIVERSITY. Progress Report, November 1, 1974–September 30, 1975. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Oct 1975. Contract AT(40-1)-3509. 17p. Dep. NTIS $4.50.

Experimental research in gravitation and strong interaction phenomenology is summarized. A list of publications is included. (JFP)

6366 (RL-75-098) K^-p REACTIONS FROM 0.960 TO 1.355 GeV/c INVOLVING TWO-BODY FINAL STATES. Conforto, B.; Gopal, G. P.; Kalmus, G. E.; Litchfield, P. J.; Ross, R. T.; Van Horn, A. J.; Bacon, T. C.; Butterworth, I.; Clayton, E. F.; Waters, R. M. (Science Research Council, Chilton (UK). Rutherford Lab.; Imperial Coll. of Science and Technology, London (UK)). 1975. 52p. Dep. NTIS (US Sales Only) $5.50.

Data are presented from a high statistics bubble chamber experiment to study K^-p interactions in the c.m. energy range 1775 to 1957 MeV. For the reactions $K^-p \to K^-p$, $K^-p \to \bar{K}^0n$, $K^-p \to \Lambda\pi^0$ and $K^-p \to \Sigma^\pm\pi^\mp$ channel cross sections, differential cross sections and, where appropriate, polarization distributions were obtained. The channel cross sections for $K^-p \to \Sigma^0\pi^0$ are presented. In general the results are in agreement with those previously published although a significant discrepancy was found in the $\Sigma^\pm\pi^\mp$ cross sections at the lower energies. New measurements of the $\Sigma^\pm$ lifetimes were also obtained ($\tau_{\Sigma^-} = 1.49 \pm 0.03 \times 10^{-10}$ sec, $\tau_{\Sigma^+} = 0.807 \pm 0.013 \times 10^{-10}$ sec). (auth)

6367 SPIN-PARITY ANALYSIS OF THE ρ(1.71)-RESONANCE PRODUCED IN 9.1 GeV/c π^--p INTERACTIONS. Armenise, N.; Fogli, M. T.; Fogli Muciaccia, M. T.; Silvestri, A. (Univ., Bari, Italy). Lett. Nuovo Cim.; 14: No. 5, 177-183(4 Oct 1975).

An analysis of the spin-parity of the ρ(1.71) resonance is reported. The data show in a significant way that this resonance belongs to the series 1^-, 2^+, 3^-, 4^+. The experimental results seem to indicate the $J^P = 3^-$ assignment as the most probable. If so the $\rho^0\rho^-$ resonance observed should be a possible decay mode of the g meson. (JFP)

6368 MESON RESONANCES. Cresti, M. (Univ., Padua). pp 693-735 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The review of meson resonances covers two- and three-pion resonances, resonances decaying into more than three pions, and the Kπ and K$\pi\pi$ states. (JFP)

6369 K^+p INTERACTIONS AT 12.7 GeV. Holmes, R. S. Rochester, NY; Univ. of Rochester (1975). 141p. University Microfilms Order No. 75-22,745.

Thesis (Ph. D.).

Results are presented from a study of reactions observed in K^+ collisions with protons. The study was conducted in the Brookhaven National Laboratory's 80-inch hydrogen filled bubble chamber, using an incident beam of K^+ mesons at a momentum of 12.7 GeV/c. The properties of the g meson are examined via the reactions K^+p yields K^0 p $pi^+pi^+pi^-pi^0$ and K^+p yields K^0p pi^+pi^0. The observed branching ratio of g yields 2 pi/g yields 4 pi is not consistent with previously measured rates obtained in pi p collisions, suggesting that the g-meson region may have more resonant structure than previously expected. The momentum transfer distribution and density matrix elements of the reactions K^+p yields DELTA$^{++}K^0$ (890), K^+p yields pK^{*+} (890) and K^+p yields DELTA$^{++}K^0$ are presented. An observation is made about the form of the t distribution of these and other similar reactions. In particular, it is found that reactions involving DELTA production, where pi-meson exchange is feasible, have a simple universal form. An analysis is given of the K^+ - pi^+ ambiguity in the K pipi low mass region for the final state of the reaction K^+p yields $K^+ppi^+pi^-$. This new analysis suggests that the low mass Kpipi enhancement (Q) has a far smaller Krho component than is commonly believed. The decay moments of the K^+pi^- for events in the Q-enhancement, are presented and implications for the Q production mechanism as well as the nature of the Q are discussed. A brief summary is presented of the time-shared computer system which represents a significant upgrading of the capability of the Rochester film-data acquisition system. (Diss. Abstr. Int., B)

Particle Interactions and Properties (Theoretical)

General

6370 (DESY-75/34) $e^+e^- \to$ HADRONS: RESULTS FROM THE DESY-HEIDELBERG-COLLABORATION. Heintze, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Sep 1975. 24p. (CONF-750855-6). Dep. NTIS (US Sales Only) $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

Inclusive photon spectra and photon spectra for events with 4 prongs and 1 γ-ray which result from the decay of the (3.1) and (3.7) resonances are presented. The decay (3.7) $\to$ (3.1) + $\gamma\gamma$ is observed confirming earlier results of the DASP collaboration. In an investigation of 3 γ final states, the decay modes (3.1) $\to \eta\gamma$ and (3.1) $\to \eta'\gamma$ are detected. In addition, the data indicate the existence of a new heavy mass particle at 2.75 GeV which decays into two photons. This conclusion is based on an analysis of the 3γ events from (3.1) decays combining results of the DASP and of the DESY-Heidelberg collaboration. (auth)

6371 (FERMILAB-75/70-THY) HEAVY QUARKS AND THEIR EXPERIMENTAL CONSEQUENCES. Appelquist, T. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Sep 1975. 22p. (CONF-750729-3). Dep. NTIS $4.50.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

Recent theoretical work on heavy quark dynamics is reviewed. In the context of a color gauge theory of strong interactions, the structure of heavy quark-antiquark bound states and their decay properties is discussed. The emphasis is on the dynamical differences between heavy and light quark bound states. It is suggested that the former will more directly reflect the structure of the underlying field theory. (auth)

6372 (JINR-P2-9156) ARE TWO-COMPONENT MODELS VALID IN THE ENERGY REGION OF APPROX. 10^4 GeV. Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1975. 11p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A possible violation of two-component models of the multiple particle production in the energy region of ~10^4 GeV is discussed. The experimental data are presented that contradict the predictions of these models. (auth)

6373 (RL-75-125) SCALING LAWS AND QUARK MODEL IN HIGH ENERGY STRONG INTERACTIONS. Dias de Deus, J. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1975. 34p. Dep. NTIS (US Sales Only) $5.00.

The evidence for simple scaling laws in inelastic production cross sections is reviewed. These laws include KNO scaling for multiplicity distributions and geometrical scaling (GS) of the impact parameter overlap function. A possible connection between these laws and the extension of GS to differential elastic cross sections are discussed. As a way to relate scaling functions in different processes use is made of the quark model. The additive (single scattering) quark model is shown to be not sufficient to interpret the existing data. Corrections coming from multiple scattering (eikonalization) and SU(N) breaking agree, at least qualitatively, with data. (auth)

6374 STATICS FOR THE ANTISYMMETRIC TENSOR POTENTIAL DUE TO CLOSED STRINGS. Kalb, M. (Yale Univ., New Haven). Nuovo Cim.; 29A: No. 3, 364-372(1 Oct 1975).

The properties, in the static limit of the antisymmetric tensor field, introduced by Kalb and Ramond to describe string interactions. Explicit expressions are obtained for a closed, circular string. These solutions indicate the lack of a monopole source. The coupling between two circular strings is calculated, leading to the hypothesis of a "sense" for closed strings. (auth)

6375 OPERATOR APPROACH TO MULTIPERIPHERAL DYNAMICS. Bassetto, A. (Univ., Trento, Italy); Bonora, L.; Pasti, P. Nuovo Cim.; 29A: No. 3, 427-443(1 Oct 1975).

The general multiperipheral equation in the operator form proposed by Bassetto, Sertorio, and Toller. After projection on the irreducible representations of the invariance semi-group, one discusses the structure of the kernel, defined as an operator in the completed tensor product of the internal Banach space, the semi-group representation space and of a Banach space related to the radial variables. Using the spectral-radius convergence criterion, one derives an analyticity domain for the resolvent operator in the complex angular-momentum variable, which is in a sense maximal. The relevance of the result to the bootstrap problem in the light of the Finkelstein-Kajantie difficulty is illustrated. (auth)

6376 EVIDENCE TO EXISTENCE OF CHARMED PARTICLES. Tyashkin, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 22: No. 1, 181-185(Jul 1975). (In Russian)

In view of the problem of a search for charmed particles a possible experiment is discussed that, simultaneously with detection of a new particle, would provide evidence of a new quantum number, conserved in strong interactions. (auth)

6377 ASYMPTOTIC RELATIONS BETWEEN TOTAL AND DIFFERENTIAL CROSS SECTIONS IN CROSS CHANNELS. Meiman, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 3, 791-805(Mar 1975). (In Russian)

Asymptotic relations for the total and differential cross sections of $AB \to CD$ and $\bar{C}B \to \bar{A}D$ reactions are derived by a single method by representing the reaction amplitudes $f_{P,A}(s; t)$ for a given $t \leq 0$ in the form of a complex potential of a simple layer. Various modifications of the relations are presented, including integral forms of the Pomeranchuk theorem. An aymptotic representation for the amplitude phase shifts $\psi_{P,A}(s; t)$ at high energies is obtained which follows from the analyticity and cross symmetry. From these relations it directly follows that a sufficient, but not all necessary condition for asymptotic equality of the cross sections is $\psi_{P,A}(s; t) = o(\ln s)$. The most complicated case, when amplitudes $f_{P,A}(s; t)$ possess an infinite number of real zeros, is considered for the first time. (auth)

6378 CORRECTIONS TO THE SCALING LAWS IN THE THEORY OF INTERACTION POMERONS. Migdal, A. A.; Polyakov, A. M.; Ter-Martirosyan, K. A. Zh. Eksp. Teor. Fiz.; 68: No. 3, 817-822(Mar 1975). (In Russian)

Corrections to the scale-invariant solution of the equations interacting pomeron theory of the form $1/\ln^{\alpha_i}s$ are calculated. Corrections to σ^{tot} of the order of $1/\xi$ arise as a result of the effective charge differing from its constant asymptotic value which it has at $\xi \to \infty$. The remaining corrections which are $\sim 1/\xi^{\alpha_i}$, where $\alpha_i > 1$ are due to the contribution of incompletely enhanced graphs and in particular of graphs containing vertices of absorption and emission of two pomerons by a particle and vertices of direct four-pomeron interaction. Indices α_i of some of the more important terms are obtained. A general method for calculating the numbers α_i is not presented. (auth)

6379 QUARKS IN ASTROPHYSICS. Ivanenko, D. D.; Kurdgelaidze, D. F.; Maksiukov, N. (Univ., Moscow). Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: 667-671(1974). (In Russian)

The principal parameters (number of quarks, pressure, density of matter, mass, and radius) of equilibrium quark configurations having core densities of from 10 to the 19th to 10 to the 32nd grams per cu cm are examined. It is shown that such objects must have a large gravitational mass defect. On the assumption that quarks can recombine into hyperons, it is shown that the number of recombined quarks is of the order of the total number of quarks in the star, and that the ratio of the number of recombined to that of free quarks is one one-millionth. (IAA)

6380 HIGH ENERGY SCATTERING OF THE COMPOUND PARTICLES IN THE FUNCTIONAL APPROACH. Nguen Suan Khan; Nesterenko, V. V. (Moscow State Univ.). Teor. Mat. Fiz.; 24: No. 2, 195-205(Aug 1975). (In Russian).

The method for construction of the scattering amplitude is developed for the case when compound particles are present. The functional integration is used. In the high energy region the amplitude of scattering of elementary particles by the compound particle ("deuteron") goes over to the Glauber representation for the amplitude of scattering by the weakly bound system. (auth)

6381 NEW PARTICLES AND BREAKING THE COLOR SYMMETRY. Krolikowski, W. (Kaiserslautern Univ., Ger.). Acta Phys. Pol., Ser. B; B6: No. 5, 727-740(1975).

In the framework of one-gluon-exchange static forces mediated by a color octet or nonet of vector gluons, quark binding in colored-meson states and its connection with breaking the color symmetry are discussed. A possible identification of $\psi(3.1)$, $\psi(3.7)$ and the broad bump at 4.1 GeV with some colored bound states of quarks and antiquarks is pointed out. This identification implies the existence of a second bump in the region of 5 GeV. The general conclusion is that the color interpretation of the new particles may be true only if the color symmetry is badly broken (provided the considered forces are relevant). (auth)

6382 SEVERAL WAYS OF BREAKING THE COLOR SYMMETRY. Krolikowski, W. (Kaiserslautern Univ., Ger.). Acta Phys. Pol., Ser. B; B6: No. 5, 707-720(1975).

Some cases of color-symmetry breaking and its implications for quark binding by one-gluon-exchange forces. Special attention is paid to the case, where color-isospin and color-hypercharge subsymmetries are preserved. Then, the ω-Φ-like mixing of color-nonet components 0 and 8 leads to a Zweig-type approximate selection rule for decays of Φ-like meson = $\bar{q}_B q_\beta$ (q_B is the "blue" quark) into ordinary mesons (and photons). (auth)

6383 RELATIVISTIC EQUATIONS FOR PARTICLES WITH ARBITRARY SPIN. Giesen, R. Helv. Phys. Acta; 48: No. 3, 261-286(1975). (In German).

Relativistic equations for particles with arbitrary spin are constructed, which admit the introduction of interactions. The equations fulfil the conditions proposed by M. Fierz and W. Pauli in 1939. (auth)

6384 FIELD CONFINEMENT AND STRING MODEL. Takahashi, K. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 14: No. 4, 139-142(27 Sep 1975).

The spinning string is described in terms of a two-dimensional field theory. An interesting mechanism concerning confinements of fields into a thin world sheet was previously proposed in which a special type of interaction between a massive local field and a magnetic flux field associated with a dipole. Then one can know how the equation of motion of a field in space–time is converted to a two-dimensional form when a confinement into the world sheet is accomplished. This mechanism is studied to know what kind of subsidiary condition in two dimensions is suggested by the one in the familiar Minkowski space. (JFP)

6385 SCALAR PARTICLE IN AN EXTERNAL SCALAR WAVE FIELD: A NEW FUNCTIONAL INTEGRAL. Barducci, A. (Univ., Florence). Lett. Nuovo Cim.; 14: No. 4, 119-122(27 Sep 1975).

From previous work in which the path integral formalism together with a careful application of the contact transformation theory, the interaction between a scalar particle of mass m and an external wave field of the form $\phi = \phi(k \cdot x)$ with $k^2 = 0$, which gives also the opportunity to evaluate exactly another unknown nontrivial functional integral. (JFP)

6386 HIGHLIGHTS IN PARTICLE PHYSICS. Volume 10. 1972 International School of Subnuclear Physics, Erice, Sicily, Italy, July 7–29, 1972. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973). 897p. (CONF-720750–).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972).

Separate abstracts were prepared for the 24 papers presented. (JFP)

For abstracts of individual papers see: 6122, 6351, 6368, 6387–6390, 6422–6426, 6441, 6445–6447, 6459–6461, 6474, 6487, 6488, 6498, and 6627.

6387 10 YEARS OF THE INTERNATIONAL SCHOOL OF SUBNUCLEAR PHYSICS ETTORE MAJORANA. Jentschke, W. (CERN, Geneva). pp 3-8 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750–.

A brief review is given of particle physics from 1957. It is noted that these ten years have been very exciting and have contributed tremendously to a better understanding of the physical processes in the microcosmos, but many questions including fundamental ones are still open. (JFP)

6388 RUDIMENTS OF LIGHT-CONE PHYSICS. Jaffe, R. L. (Stanford Univ., CA). pp 301-322 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

An elementary exposition of the concepts and mathematical techniques of light cone physics is given including light-cone dominance, light-cone expansions and the measurement of light-cone singularities, free field light-cone singularities, and the proton model without partons. (JFP)

6389 RECENT PROGRESS IN DUAL MODELS. Di Vecchia, P. D. (CERN, Geneva); Fubini, S. pp 351-373 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

Some of the exciting new developments in the field of dual models are described; in particular, the very important no-ghost theorem. Included are the properties of the spectrum of the dual resonance model, vertex operators for the physical state and transverse states, and the absence of ghosts in the dual resonance model. (JFP)

6390 HOW TO DEAL WITH HIGHER SPIN INTERACTING PARTICLES. Velo, G. (Univ., Bologna). pp 439-449 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

Some problems which arise in the theory of relativistic wave equations describing massive higher spin interacting particles are discussed. (JFP)

6391 PROBLEMS RELATED TO DESCRIPTION OF PARTICLE DECAY. Lokajicek, M. V. (Inst. of Physics, Prague). Acta Phys. Austriaca; 40: No. 1, 37-42(1974).

Two alternative groups of mutually consistent assumptions on which a theory of decay processes could be built up are discussed. (auth)

6392 POSSIBLE ALGEBRA OF FIRST AND SECOND CLASS CURRENTS. Stremnitzer, H. (Univ., Vienna). Acta Phys. Austriaca; 40: No. 1, 27-36(1974).

A lecture is given on some theoretical implications from the existence or nonexistence of second-class currents. Included are properties and tests of second-class currents, higher symmetry in strong interactions, applications, and leptons. (JFP)

6393 UNITARITY SUM RULES. Muetter, K. H. (Univ., Heidelberg). Acta Phys. Austriaca; 40: No. 1, 2-14(1974).

Knowledge to be derived from the unitarity sum rules and the pole structure of the six- and eight-point functions is discussed. Only one type of spinless particles with mass μ is considered. It is noted that the unitarity sum rules can be used to study the way in which the inelastic part of the four-point function is constrained via unitarity by the one-, two-, ... inclusive cross sections. (JFP)

6394 ARE QUANTUM PROCESSES COSMOLOGICALLY INDUCED. Opher, R. (Israel Inst. of Technology, Haifa). Found. Phys.; 5: No. 2, 307-321(Jun 1975).

Why, among approximately 10^{16} possibilities, does a wave function of a fast ion, spread over several centimeters, collapse in a crystal within a region measuring a few angstroms across. The most direct answer to this question would be the existence in this region of a cosmic particle, called a dybbuk, which induces the collapse. If dybbuks exist, deviations from conventional theory might be expected to occur for experiments involving ultrasmall space–time intervals less than the characteristic space–time interval of a dybbuk. It is shown that a dybbuk theory having the above characteristics can be constructed and can be tested experimentally by the decay of a 0^- (J/sup P/) meson into two vector mesons. (auth)

6395 SCATTERING OF COMPOSITE PARTICLES AND QUASIPOTENTIAL APPROACH IN QUANTUM FIELD THEORY. Garsevanishvili, V. R.; Kvinikhidze, A. N.; Matveev, V. A.; Tavkhelidze, A. N.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 25: No. 1, 37-42(Oct 1975). (In Russian).

Scattering of composite particles is considered on the basis of the «light-front» formulation of the quasipotential approach in quantum field theory. (auth)

Electromagnetic

Refer also to abstracts 6334 and 6634.

6396 (DESY-75/30) INFLUENCE OF ANOMALOUS THRESHOLDS IN ELECTRON–POSITRON ANNIHILATION INTO HADRONS: THE e^+e^- → rho $\pi\pi$ CROSS SECTION. Kramer, G.; Schierholz, G.; Sundermeyer, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1975. 43p. Dep. NTIS (US Sales Only) $5.00.

The cross section for $e^+e^- \to \rho\pi\pi$ is calculated on the basis of partial-wave dispersion relations in the $\pi\pi$ channel taking proper account of anomalous singularity contributions. The appearance of anomalous thresholds is due to the fact that the vertex $\gamma_\mu\rho(\pi\pi)$ becomes internally unstable as the virtual photon mass is increased. Reasonable agreement with existing data is found. The anomalous singularity contributions provide by far the dominant part of the cross section which is a warning to using naive vector dominance extrapolations in estimating the electron-positron cross section. (auth)

6397 (LBL-4260) ANALYSIS OF A REPORTED MAGNETIC MONOPOLE. Alvarez, L. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 16 Sep 1975. Contract W-7405-ENG-48. 24p. (CONF-750855-3). Dep. NTIS $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

It is shown that there are several substantive errors in a previous work on a cosmic ray event which is consistent with the hypothesis that it was caused by a magnetic monopole. It is shown that the data points fit to the hypothesis that the responsible particle is a platinum nucleus fragmenting to osmium and then to tantalum. (JFP)

6398 (SLAC-PUB--1650) THEORY OF ELECTRON--POSITRON ANNIHILATION INTO HADRONS. Gilman, F. J. (Stanford Linear Accelerator Center, Calif. (USA)). 1975. 24p. (CONF-750853--5). Dep. NTIS $4.50.

From symposium on lepton and photon interactions; Stanford, California, USA (21 Aug 1975).

The total cross section for e^+e^- yields hadrons and R, its ratio to the muon pair cross section, the physics below and above the threshold near 4 GeV cms with particular attention to what is changing there and exactly where it happens, and inclusive distributions and jets of final state hadrons are treated. (auth)

6399 STRUCTURE FUNCTIONS OF REGGE RECURRENCES AND DUAL LIGHT-CONE BEHAVIOR. Schmidt, M. G. (Univ., Heidelberg). Nuovo Cim.; 29A: No. 3, 398-414(1 Oct 1975).

Spin-averaged deep inelastic structure functions of particles on a Regge trajectory are presented in terms of the structure function of its lowest lying member. They are extracted from a dual-model ansatz for Compton scattering off two particles which leads to canonical scaling. Part of the result is confirmed in the Bethe-Salpeter bound-state picture. The implications of the results for deep inelastic e^-e^+ annihilation where inclusive resonance production plays an important role. (auth)

6400 NONLINEAR THEORY OF ELECTRON BEAM EXCITATION OF SURFACE ELECTROMAGNETIC WAVES IN A DIELECTRIC MEDIUM. Dolzhenko, O. V.; Loladze, Ts. D.; Ivanov, S. T.; Rukhadze, A. A.; Chogovadze, M. E. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1304-1310(Apr 1975). (In Russian)

The problem of excitation of nonlinear surface electromagnetic waves at a dielectric medium–vacuum interface by a relativistic electron beam passing over the surface of the dielectric is solved. Nonlinear field equations and their boundary conditions are obtained under the condition of strong magnetization of the electron beam. Stationary values of the amplitudes of monochromatic surface waves excited by the beam are found. The radiation energy fluxes and efficiency for transformation of beam energy into radiation energy near the saturation threshold are determined. (auth)

6401 NEUTRAL SYSTEM OF TWO CHARGED INTERACTING PARTICLES IN A MAGNETIC FIELD. Ryvkin, M. Sh. (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR; 221: No. 1, 67-69(1975). (In Russian)

A case of separating variables both in the classical and also in the quantum mechanical problem is pointed out, and a number of the consequences are considered. This separation of variables had apparently not been noted previously. The separation of variables is attained in the case where the charge $e_1 = -e_2 = e$. It is shown that the motion of the center of inertia is on the average inertial, and the relative energy is conserved on the average. (SJR)

6402 APPLICATION OF THE STRING MODEL OF HADRONS TO THE INELASTIC SCATTERING OF ELECTRONS. Tassie, L. J. (Australian National Univ., Canberra). Aust. J. Phys.; 28: No. 1, 15-20(Feb 1975).

A simple string model of hadrons, which is in agreement with scaling, is applied to the deep inelastic scattering of electrons

by the nucleon and is used to make predictions of the average charge and the types of particles produced. In particular, the total baryon number of the particles produced in the photon fragmentation region is shown to be 0 for x approximately equal to 0 and 1 for x approximately equal to 1, where x is the Bjorken scaling variable. (auth)

6403 QUANTUM THEORY OF VAVILOV–CHERENKOV RADIATION EMITTED BY AN ELECTRON MOVING IN VACUUM PARALLEL TO THE SURFACE OF A DIELECTRIC. Batygin, V. V.; Kuz'menko, N. K. (Leningrad Polytechnic Inst.). Zh. Eksp. Teor. Fiz.; 68: No. 3, 881-888(Mar 1975). (In Russian)

The probabilities of soft and hard (both spontaneous and stimulated) Vavilov–Cherenkov radiation emitted by an electron moving in vacuum parallel to the surface between a dielectric and vacuum are calculated. Angular and spectral distributions of hard Cherenkov quanta are found and the probabilities are estimated. Some characteristic properties of hard Vavilov–Cherenkov radiation are noted. The principle possibility of experimentally observing Cherenkov quanta is discussed. (auth)

6404 CHARACTERISTICS OF LONGITUDINAL DEVELOPMENT OF ELECTRON–PROTON SHOWERS INDUCED BY 30 TO 120 MeV γ QUANTA IN LIQUID XENON. Okhrimenko, L. S.; Slovinskii, B.; Strugal'skii, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 22: No. 1, 110-115(Jul 1975). (In Russian)

The development lengths and the total ranges of shower electrons are studied as well as the corresponding fluctuations in the showers induced by the γ quanta with their energies of 30, 50, 70, 100, and 120 MeV in the liquid xenon. The scaling is found in the integral cascade curves and in the dependence of fluctuations upon the part of the total range of the shower electrons. (auth)

6405 RESONANT INTERACTION BETWEEN ELECTRONS AND PHOTONS. Fedorov, M. V. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1209-1219(Apr 1975). (In Russian)

Resonant emission (absorption) of photons by electrons in the presence of two external electromagnetic waves is considered. The behavior of an electron in such fields is found to resemble that of a two-level system subjected to resonant perturbation. The induced radiative width and shape of the resonance line is found by summation of an infinite series of resonance diagrams. Some features of the Kapitza–Dirac effect under conditions of adiabatic attenuation of a standing wave and on application of a third field are considered. It is shown that in this case scattering occurs in directions which differ from that of ordinary specular reflection. The probabilities for resonant scattering are found in the nonrelativistic approximation. (auth)

6406 SCATTERING OF POLARIZED VECTOR PARTICLES ON COMBINED POTENTIALS. Ferents, P. R.; Kostarev, A. I.; Gerasimchuk, B. V. (Lvov Polytechnical Inst.). Vestisi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 132-135(1975). (In Russian)

Expressions were obtained for the differential scattering cross section of vector particles in a field representing the superposition of electric Coulomb screening centers and separable axial magnetic potentials. During the calculations the magnetic and electric quadrupole and internal electric dipole moments of the vector were considered. (tr-auth)

6407 GRAVITATIONAL RADIATION EMITTED BY AN ELECTRON IN THE FIELD OF A CIRCULARLY POLARIZED ELECTROMAGNETIC WAVE. Gal'tsov, D. V.; Grats, Yu. V. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 3, 777-785(Mar 1975). (In Russian)

Gravitational radiation emitted by a charged particle located in the field of a circularly polarized plane electromagnetic wave is considered in the linear approximation of general relativity theory. It is shown that in contrast to the case of gravitational radiation from a relativistic particle in a slowly varying field, the intensity of the radiation is proportional to the sixth, and not the fourth power of the ratio (E/m). A formula is also derived for one-graviton pair annihilation in the presence of an electromagnetic wave. The limiting transition to a stationary field is discussed. (auth)

6408 COMPTON SCATTERING OF LASER γ QUANTA ON POLARIZED RELATIVISTIC ELECTRONS. Grinchishin, Ya. T. (Lvov Polytechnic Inst.). Yadern. Fiz.; 22: No. 1, 136-140 (Jul 1975). (In Russian)

Angular distribution and polarization degree of final photons produced in the central collision of polarized high energy electrons with laser polarized γ quanta are investigated in region of small angles (10^{-5} rad. in lab. system). The advantage of such an electron beam in view of the production of circular-polarized high energy photons is shown. It is found that the degree of circular polarization, as well as the monochromaticity, of the photon beam is improved with rising energy of the incident electron or the γ quantum. (auth)

6409 INTERACTION OF SOFT PHOTONS WITH A CHARGED PARTICLE. Pron'ko, G. P. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 22: No. 1, 141-146(Jul 1975). (In Russian)

The threshold theorem is obtained in the S matrix electrodynamics for Compton scattering up to the terms determining the dynamical polarizability of a charged particle. The asymptotics of the electromagnetic form factor at small transfers is obtained. (auth)

6410 GENERAL RELATIVISTIC VARIATIONAL FORMALISM FOR TEST PARTICLES WITH MOMENTS. Minkevich, A. V.; Sokol'skii, A. A. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 72-80(1975). (In Russian)

On the basis of the oriented particle model a variational formalism was developed for test particles with moments, moving in a nonhomogeneous space-time. Lagrangian equations of the translational and rotational motion were obtained. The metric tensor of the energy-momentum was found. The formalism was applied to the charged rotating particles with electrical and magnetic moments. It was also applied to rotating particles in space with curvature and torsion. (tr-auth)

6411 PARTIAL SCREENING OF QUARK CHARGE. Krolikowski, W. (Kaiserslautern Univ., Ger.). Acta Phys. Pol., Ser. B; B6: No. 5, 721-725(1975).

The hypothesis of vector-gluon dominance over the colored part of the photon, if true, implies a phenomenon of partial screening of quark charge, which may be responsible for noninteger values of quark charges as "observed" at present in deep inelastic electron scattering. An average rise of R-ratio in e^-e^+ annihilation is a necessary condition for the hypothesis. This hypothesis also implies that (besides strong decays) the first-order radiative decays of colored states into non-colored states are forbidden if strong interactions are color symmetric. (auth)

6412 AZIMUTHAL DEPENDENCE OF THE INCLUSIVE ELECTROPRODUCTION IN THE LIGHT-CONE APPROACH. Kotsinyan, A. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 24: No. 2, 206-210(Aug 1975). (In Russian).

The azimuthal dependence is considered for the inclusive electroproduction in deep inelastic target fragmentation region. It is shown that the parton model prediction on the azimuthal independence of the cross section in this region may also be obtained by the light cone analysis. (auth)

6413 NONUNIVERSALITY OF THE G/E RELATION IN THE RELATIVISTIC KEPLER PROBLEM. Biza, Yu. S.; Tomil'chik, L. M. (Inst. of Physics, Minsk). Teor. Mat. Viz.; 24: No. 3, 325-332(Sep 1975). (In Russian).

Effect of g/e-relation nonuniversality on the energy spectrum of a relativistic hydrogen-like system is investigated. The first order correction to the energy eigenvalues for $\frac{1}{2}$ spin case (the Dirac equation) is calculated. It is shown that in this case the twofold degeneracy which takes place in the ordinary relativistic Kepler problem removes itself, which can be interpreted as a peculiar Lamb shift imitation. Direct evaluation of the upper limit for possible magnetic proton and muon charges is made with the aid of the comparison between the results obtained and known experimental and theoretical data concerning Lamb shift numerical value in ordinary atoms and mumesonic atoms. (auth)

6414 CONVEXITY OF THERMODYNAMIC POTENTIALS IN HEREDITARY ELECTROMAGNETISM. Fabrizio, M. (Istituto Matematico, Bologna). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Nat.; 55: No. 2, 241-248(1973). (In Italian).

A convexity principle is given for electromagnetic energy relative to memory materials. This property makes it possible to express correctly the Cauchy problem for Maxwell equations. (tr-auth)

6415 SPIN-1 ELECTROMAGNETIC VERTEX FUNCTION. Phares, A. J. (International Center for Theoretical Physics, Trieste, Italy). Acta Phys. Pol., Ser. B; B6: No. 3, 365-378 (1975).

The e^3 contribution to the electromagnetic vertex function of spin-1 particles is calculated in the framework of source theory. A magnetic moment of arbitrary strength κ is included in the primitive interaction. In particular, the quadrupole form factor is shown to be finite with no need of adding any contact term if and only if $\kappa = 1$. A general discussion of the contact terms is included, and the explicit expressions of the form factors are obtained

along with their asymptotic behavior, when $\kappa = 1$. The dynamically induced quadrupole moment, in that case, is calculated to be $\alpha/18\pi$, and the associated spectral form is superconvergent. (auth)

6416 GREEN FUNCTION OF THE ELECTRON IN A FIELD OF QUANTIZED WAVES. Fedorov, M. V. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 99-104(1975). (In Russian).

The Green function of the electron in a field of quantized free monochromatic waves was found. A method was proposed for the construction of a complete orthonormal system of wave functions for this problem. (tr-auth)

6417 RADIATION RELAXATION OF A RELATIVISTIC ELECTRON GAS IN A CONSTANT HOMOGENEOUS MAGNETIC FIELD. Khalilov, V. R.; Chizhov, G. A.; Rodionov, V. N. (Moscow State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 20-24 (1975). (In Russian).

Equations are derived which describe the relaxation of a relativistic electron gas in a strong homogeneous electromagnetic field because of the radiation and absorption of the electromagnetic waves by the electrons. (JSR)

6418 CHARGE SYMMETRY OF ELECTRON WAVE FUNCTIONS IN THE FIELD OF QUANTIZED ELECTROMAGNETIC WAVES. Fedorov, M. V. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 29-34(1975). (In Russian).

The destruction of charge symmetry in known wave functions of the electron in a field of quantized waves was discussed. An attempt was made to modify the equations and solutions free from this deficiency were constructed. (tr-auth)

6419 η PUZZLE AND THE $\Delta I = 1$ ELECTROMAGNETIC-MASS DIFFERENCES IN COLOR GAUGE THEORIES OF STRONG INTERACTIONS. Marcolungo, P. (Univ., Padua). Lett. Nuovo Cim.; 14: No. 4, 131-134(27 Sep 1975).

It is shown that the problem of $\eta \to 3\pi$ decay also finds a solution in the context of color gauge theories. An anomalous divergence equation is assumed for the axial baryon current in order to allow nonvanishing contributions from matrix elements of the pseudoscalar baryon current between equal-momentum states. (JFP)

6420 $\Delta I = \frac{1}{2}$ RULE OF NONLEPTONIC WEAK DECAYS AND DIQUARK STATES IN COLOR GAUGE THEORIES OF STRONG INTERACTIONS. Marcolungo, P. (Univ., Padua). Lett. Nuovo Cim.; 14: No. 4, 135-138(27 Sep 1975).

If it is assumed that diquark states contribute strongly to the current-current product, from a Fierz transformation of the second kind on the product of two charged weak currents, one obtains octet dominance. It is briefly discussed what evidence the theory of current-current interactions adds to the existence of diquark states. These include the ideas that the approach is easy also to electromagnetic interactions and helps to explain the puzzle of electromagnetic mass differences and $\eta \to 3\pi$ decay. In this way one emphasizes properly the connection between the $\Delta I = \frac{1}{2}$ rule and the problem of hadron spectroscopy. Finally, one obtains a quantitative agreement with the observed small violation of the $\Delta I = \frac{1}{2}$ rule and consequently a correct size enhancement of nonleptonic interactions over semileptonic and leptonic ones. (JFP)

6421 PROPAGATION OF PHOTONS IN HOMOGENEOUS MAGNETIC FIELDS: INDEX OF REFRACTION. Tsai, W. Y. (Univ. of California, Los Angeles); Erber, T. Phys. Rev. Lett.; 12: No. 4, 1132-1137(15 Aug 1975).

The index of refraction associated with the vacuum polarization induced by homogeneous magnetic fields is calculated for two cases: high energy photons traversing fields weak compared with the critical field, H/sub cr/ equals m^2c^3/eh approximately 4.41 x 10^{13} G; and low energy photons in fields of arbitrary intensity. Some implications for the physical optics of intense magnetic fields are briefly discussed. (auth)

6422 DEEP INELASTIC PHENOMENOLOGY AND LIGHT CONE PHYSICS. Brandt, R. A. (New York Univ., New York). pp 129-225 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

A review is given of present understanding of inelastic electron-nucleon scattering phenomenology. No attempt is made to explain the experimental data, but rather they are summarized and parametrized. Deep inelastic phenomenology and light-cone physics are considered. (JFP)

6423 MASS DISPERSION RELATIONS AND e^+-e^- COLLISIONS IN THE PHYSICS OF THE LIGHT CONE. Preparata, G. (Univ., Rome). pp 227-299 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The treatment includes the general aspects of mass dispersion relations and the crucial problem of light cone dominance in certain kinematic limits, applications of the formalism to amplitudes involving electromagnetic currents, the problem of PCAC in two very interesting cases, and the continuation of light cone amplitudes from the deep inelastic scattering to the deep inelastic annihilation region. (JFP)

6424 COHERENT BREMSSTRAHLUNG IN CRYSTALS. Ferretti, B. (Univ., Bologna). pp 331-349 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

An historical survey is given of effects which arise when electrons, positrons, or photons impinge on a crystal with high energy ($\geq$ 1 GeV in the crystal's frame) is given. This survey includes breakdown of the Born approximation, analysis of the reasons for the unitarity breakdown with some results of an improved theory, and hints on the research work still in progress. (JFP)

6425 ELECTROMAGNETIC INTERACTIONS OF HADRONS. Lohrmann, E. (DESY, Hamburg). pp 513-547 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The treatment of electromagnetic interactions of hadrons covers the vector meson-photon analogy, vector meson dominance, Compton scattering and total hadronic cross sections, photoproduction of pseudoscalar mesons, and symmetry properties of the photon. (JFP)

6426 QUANTUM ELECTRODYNAMICS OF LEPTONS. Farley, F. J. M. (Royal Military Coll. of Science, Wiltshire, Eng.). pp 549-579 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The quantum electrodynamics of leptons considered includes types of experiments, fine structure constant, the Lamb shift, (g-2) experiments, the (g-2) of the electron and muon, high energy tests, and Delbruck scattering and photon splitting. (JFP)

6427 VALENCE-PARTON APPROXIMATION. Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys.; 23: No. 4, 475-484(1975).

One derives from experimental data the "valence-parton approximation" to deep inelastic electron and neutrino scattering of the nucleon. In this approximation the nucleon consists of three quarks and some neutral partons (= "coquarks"). Under the assumption of average momentum equipartition, the number of coquarks is also three. (auth)

6428 THEORETICAL DETERMINATION OF THE ELECTRONIC REST MASS. Kobus, J. P. Found. Phys.; 5: No. 2, 343-347(Jun 1975).

A theoretical relation for the electron rest mass is derived in terms of the electron charge, Planck's quantum of action, and the speed of light. The basis for this derivation is an assumption that the electron rest mass is entirely electrostatic in origin, combined with the realization that the maximum action density of the world is simply the speed of light. Planck's quantum of action becomes perspicuously associated with an elliptical microspace. (auth)

6429 ELECTROMAGNETIC INTERACTION OF NEUTRINOS IN GAUGE THEORIES OF WEAK INTERACTIONS. Cung, V. K.; Yoshimura, M. (Univ. of Pennsylvania, Philadelphia). Nuovo Cim.; 29A: No. 4, 557-564(21 Oct 1975).

The scattering of neutrinos off real or virtual photons is examined in the gauge theories of weak interactions. Finite amplitudes of order G alpha are calculated in the fourth-order perturbation for various models. (auth)

Weak

6430 (ANL/HEP-CP-75-40) REACTION nu d yields mu$^-$ pp/sub s/. Barish, S. J.; Derrick, M.; Hyman, L.; Musgrave, B.; Schreiner, P.; Singer, R.; Barnes, V.; Carmony, D.; Garfinkel, A. (Argonne National Lab., Ill. (USA)). 1975. 5p. (CONF-750853-2). Dep. NTIS $4.00.

From symposium on lepton and photon interactions; Stanford, California, USA (21 Aug 1975).

After making the usual model assumptions, the shape of the d sigma/dQ^2 distribution and the energy dependence and magnitude

of the cross section were fit in order to determine the shape of the form factors for the reaction nu d yields mu⁻pp. It is noted that one can also test the CVC hypothesis. The cross section is shown as a function of neutrino energy for the nu n yields mu⁻p reaction. Also shown is the Q^2 dependence of the nu n yields mu⁻p events. (JFP)

6431 (LBL-4275) DETERMINATION OF THE K⁰/sub L/ YIELDS pi⁻mu⁺nu/sub mu/ FORM FACTOR xi(q^2) BY MUON POLARIZATION MEASUREMENTS. Shen, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-eng-48. 115p. Dep. NTIS $6.50.

Thesis.

The polarization of the muon in the decay K⁰/sub L/ yields pi⁻mu⁺nu/sub mu/ was measured as a function of q^2, the four-momentum transferred to the lepton pair. The kinematic information was used to compute the polarization expected on the basis of various assumed values of the form factor xi(q^2). By comparing the interpolated curve of the polarization as a function of xi(q^2) to the experimentally measured polarization, one has determined xi(q^2) as a function of q^2. If one parameterizes the q^2 dependence of xi by xi(q^2) equals xi(0) + LAMBDA q^2/m^2/sub pi/, then xi(0) equals 0.178 ± 0.105 - 3.80 LAMBDA. (auth)

6432 (RL-75-124) LEPTONIC COUPLING-TYPES IN $K^+ \to \pi^+ l^+ l^-$ DECAYS AND THE QUESTION OF STRANGENESS-CHANGING SEMILEPTONIC NEUTRAL CURRENTS. Beder, D. S.; Dass, G. V. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1975. 14p. Dep. NTIS (US Sales Only) $4.50.

A study of the leptonic coupling types in $K^+ \to \pi^+ l^+ l^-$ (l = e, μ) provides some model-independent distinction between the various underlying mechanisms: lowest order weak cum electromagnetic vs. higher order weak interactions vs. genuine strangeness-changing semileptonic neutral currents. This distinction is necessary in order to know the existence of these neutral currents. The pion energy spectrum for l = e and the ratio of the total rate for l = e to that for l = μ is useful for this purpose, and the pion energy spectrum for l = μ is of further help. Available data (l = e only) are inadequate to provide the above distinction. Estimates of various coupling strengths are made from the observed l = e rate. (auth)

6433 EFFECTS OF CHARM AND COLOR IN DEEP INELASTIC NEUTRINO SCATTERING. Tokuda, N. (Univ., Heidelberg). Nuovo Cim.; 29A: No. 3, 335-345(1 Oct 1975).

Possible effects of the charm quantum number and color degree of freedom on deep inelastic neutrino (and electron) scattering are investigated in a twelve-quark-parton model. The weak and the electromagnetic currents which belong to the $SU_2 \otimes U_1$ gauge group are constructed appropriately in a generalized GIM scheme. It is found that the deep inelastic cross sections increase only by about 10% above the charm threshold, while above the color threshold they become about 1.7 times as large as those below the color threshold. The ratios R, $\bar{R}$ and R_c remain almost unchanged at the charm and the color thresholds. (auth)

6434 MUONLESS NEUTRINO EVENTS AND THE PHOTON-NEUTRINO WEAK-COUPLING THEORY. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta). Nuovo Cim.; 29A: No. 3, 353-363(1 Oct 1975).

One discusses the muonless neutrino events according to the photon-neutrino weak-coupling theory, and it is found that recent experimental results conform well with the theoretical predictions. It is also pointed out that strangeness-changing neutral lepton currents are not allowed in this theory and so no unnatural mechanism is needed to interpret the highly stringent limits on the processes like $K_L^0 \to \mu^-\mu^+$ and $K^+ \to \pi^+\nu\bar{\nu}$ as observed in experiments. (auth)

6435 EQUALITY BETWEEN NEUTRINO-NUCLEON AND ANTINEUTRINO-NUCLEON CROSS SECTIONS AT HIGH ENERGIES FOR FIXED FINAL HADRONIC MASS. Pestieau, J.; Urias, J. (Univ., Louvain, Belgium). Rev. Mex. Fis.; 23: No. 4, 385-390(Dec 1974).

Under a weak hypothesis it is shown that, for fixed final hadronic mass with strangeness S = 0, in the high energy limit, the total cross sections for ν-N and $\bar{\nu}$-N are equal unless the $\Delta S = 0$ (charged) weak current violates the usual charge-symmetry requirement. (auth)

6436 PARITY NONCONSERVATION IN μ MESOATOMS WITH HYPERFINE SPLITTING. Moskalev, A. N.; Ryndin, R. M. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 22: No. 1, 147-156(Jul 1975). (In Russian)

The circular polarization and angular asymmetry of the γ quanta emitted in electromagnetic transitions between separate hyperfine components of 2S and 1S levels of μ mesoatoms with $Z \leq 5$ are considered. Measurements of such correlations would make it possible to find the spin structure of the weak interaction of neutral currents. (auth)

6437 INVESTIGATION OF NEUTRAL CURRENTS IN NEUTRINO SCATTERING ON NUCLEI. Gershtein, S. S.; Folomeshkin, V. N.; Khlopov, M. Yu.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 22: No. 1, 157-165(Jul 1975). (In Russian)

Excitation of nuclear levels induced by neutrinos with low and intermediate energies is analyzed in order to determine the isotopic structure of the neutral currents. (auth)

6438 NONLEPTONIC DECAYS OF CHARMED BARYONS. Voloshin, M. B.; Zakharov, V. I.; Okun, L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 22: No. 1, 166-172(Jul 1975). (In Russian)

Nonleptonic decays of charmed baryons provide with extraordinary abundant possibilities to test various selection rules imposed on the weak interaction Hamiltonian by the Weinberg-Salam model. Relations for the dominating ($\sim \cos^2\theta_c$) two-particle nonleptonic decays of the charm-one baryons are obtained that result from the selection rules $\Delta T = 1$, $\Delta U = 1$, $\Delta V = 1,0$, as well as from a more strong rule $\Delta V = 0$. A simple relation between the masses of the charmed baryons and masses of the known particles is presented. (auth)

6439 DIFFRACTIONAL PRODUCTION OF CHARMED PARTICLES AND THE NEUTRINO EXPERIMENTS AT FNAL. Arbuzov, B. A.; Gershtein, S. S.; Lapin, V. V.; Folomeshkin, V. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 22: No. 1, 173-180(Jul 1975). (In Russian)

A possible explanation of the results of the neutrino experiments at FNAL due to diffractional production of charmed particles is considered. (auth)

6440 ELECTRON-MUON SCATTERING WITH CONSIDERATION OF POLARIZATION. Fedorov, F. I.; Khoang Van Fong. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 54-62(1975). (In Russian)

General expressions were obtained for the matrix elements and differential cross section for the scattering of electrons on muons in any frame of reference and during random polarization of all particles. Expressions for the cross section, averaged over the polarization of one and two particles, were given. A series of particular cases connected with the different selection of the particle polarization was examined. (tr-auth)

6441 WEAK INTERACTIONS AND CP VIOLATION. Winter, K. (CERN, Geneva). pp 469-511 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The main concern is with present knowledge and the problems which remain to be studied in the weak decays of particles. The discussion mostly deals with the experiments which are crucial for present understanding of the weak interaction. Included are the phenomenological theory, hadron current and its selection rules, form factors of K_{l3} decay amplitude, and CP violation. (JFP)

6442 SOME CONSIDERATIONS ON DIVERGENCES OF WEINBERG'S LEPTON MODEL. Lee, Y. Y.; Hu, C. K.; Chen, W. D. (National Tsing Hua Univ., Hsin Chu, Taiwan). 12: No. 2, 109-130(Oct 1964).

A survey of the theoretical background and basic idea of Weinberg's lepton model is given. The second order electron self energy is calculated to explore the renormalizability of the Weinberg theory in the unitary gauge. It is found that there remains residue divergences in the self energy insection on electron propagators. The possibility of cancellation and absorption of all residue divergences in the complete second order corrections to Compton scattering is investigated. It is shown that residue divergences of Z corrections can be grouped as renormalization constant of coupling constant. Similar calculation and examination of residue divergences due to W corrections is still in progress. (auth)

6443 NONRELATIVISTIC QUARK MODEL AND THE NONLEPTONIC HYPERON WEAK DECAYS. Sebastian, K. J. (Lowell Technological Inst., MA). Nuovo Cim., A; 29A: No. 4, 548-556(21 Oct 1975).

Using the nonrelativistic symmetric quark model and the Melosh transformation between the current and the constituent quark one calculates the matrix element of the current-current strangeness-changing nonleptonic weak Hamiltonian density between two nucleon octet hyperons in terms of the universal Fermi coupling constant. The result of this calculation agrees remarkably well with the value obtained for this matrix element from a previous analysis of the nonleptonic weak decays of the hyperons based on current algebra, dispersion relations, Regge asymptotic behavior, resonance saturation of the absorptive parts and some general results of the symmetric quark model. (auth)

6444 WEAK RADIATIVE DECAYS OF BARYONS IN THE QUARK MODEL. Schwarz, H. (Univ., Vienna). Lett. Nuovo Cim.; 13: No. 14, 525-528(2 Aug 1975).

Results of the nonrelativistic quark model for the nonleptonic baryonic decays are used to derive the weak radiative baryon decays. Parity conserving and parity violating amplitudes are calculated and compared with experiment. Introducing SU_3 breaking through the baryon magnetic moment improves agreement with the data. Results are regarded as a further success of the refined quark model. (SDF)

Strong (General)

Refer also to abstracts 6346, 6658, and 6660.

6445 SOME REFLECTIONS ON THEORETICAL HADRON PHYSICS, PAST ACHIEVEMENTS AND FUTURE TASKS. Van Hove, L. (CERN, Geneva). pp 12-20 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

An assessment is given of the general status of the massive research effort on theoretical hadron physics including its success and failure, experiment versus theory, the theorist as analyzer of experimental data, and unifying concepts without a coherent scheme. (JFP)

6446 CHIRAL SYMMETRIES AND CURRENT ALGEBRAS. Nambu, Y. (Univ. of Chicago). pp 103-127 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

A general introductory review is given of the spontaneous breakdown phenomenon which forms the basis of the gauge theories of quarks and vector fields (gluons) for hadron strong interaction theory. Then quark fields and extended symmetries of quark fields which might be useful in eventually building a gauge theory involving the quarks are considered. Bilinear local quark algebra is discussed. (JFP)

6447 STRONG INTERACTIONS. High Energy Phenomena. Van Hove, L. (CERN, Geneva). pp 737-765 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The study of higher-multiplicity processes includes two-body collisions, the method of analysis and the main characteristics of few-body collisions, the sharp separation between reaction mechanisms, questions of energy dependence, factorization properties, larger multiplicities, and the general outlook. (JFP)

6448 WAVE EQUATIONS FOR UNSTABLE PARTICLES AND RESONANCES: GENERAL CONSIDERATIONS AND SOLUBLE MODELS. Brzeski, A.; Lukierski, J. (Univ., Warsaw). Acta Phys. Pol., Ser. B; B6: No. 4, 577-597(1975).

A quantum-mechanical description of an unstable object, which is characterized by an equation of motion with complex energy (mass) parameter is proposed. In order to satisfy conventional axioms of QM, the source term is introduced which is proportional to the root of the imaginary part of the complex energy, and in the stable limit disappears. The decay properties are therefore characterized by a complex energy (mass) parameter and the source term which describes the deviation from "nonunitary" space-time development. Models are considered with space variables, nonrelativistic and relativistic ones. The explicit formulas for simple models of wave functions are given. Finally, the description of an unstable V-particle in NΘ-sector of the Lee model is presented within this framework. (auth)

6449 GEOMETRICAL DESCRIPTION OF HADRONIC COLLISIONS. Miettinen, H. I. (CERN, Geneva). Acta Phys. Pol., Ser. B; B6: No. 4, 625-639(1975).

The geometrical picture of hadronic collisions is discussed. ISR elastic scattering data are analyzed. Some features of multiparticle production are studied, emphasizing qualitative ways of discriminating between the geometrical and the multiperipheral models. (auth)

6450 DIFFRACTIVE-DISSOCIATIVE PROCESSES IN HIGH ENERGY HADRONIC INTERACTIONS. Schaffner, J. G. Jr. Charlottesville, VA; Univ. of Virginia (1975). 186p. University Microfilms Order No. 75-22,827.

Thesis (Ph. D.).

The effect of opening diffractive channels on hadronic cross sections at high energy is investigated. By studying such quantities as sigma/sub el//sigma/sub T/ and sigma/sub dif// sigma/sub T/ one can determine the importance of diffractive dissociative processes in scattering. Such effects are studied in three parts: A multiple scattering theory using a modified Glauber model; Relativistic treatment in an absorptive model using a field theory in the eikonal approximation; and An application to interpreting cosmic ray data, and generalized vector dominance and photon shadowing. (Diss. Abstr. Int., B)

Strong (Baryon No. = 0)

Refer also to abstract 6394.

6451 (RL-75-133) STATUS OF THE 0^+ NONET. Morgan, D. (Science Research Council, Chilton (UK). Rutherford Lab.). Aug 1975. 46p. Dep. NTIS (US Sales Only) $5.00.

The phenomenological case is presented for a complete normal scalar nonet comprising $\delta(976)$ (I = 1), $\kappa(1250)$ (I = ½), $S^*(1000)$ and $\epsilon('1200')$ (I = 0), nonideally mixed ($\theta_S \approx 65^0 \pm 5^0$ as against $\theta^{ideal} \approx 35^0$), but seemingly respecting Zweig's rule in its hadronic decays. These decays, which go almost entirely to two-body S-wave final states, exhibit the inherent kinematic complications in a simple way. This is especially so for the δ and S^* systems for each of which the resonance pole occurs just below the threshold of the strongly coupled $K\bar{K}$ channel. In the I = 0 system, to which the S^* couples, the "background" itself manifests resonance activity whose classification requires a scheme for describing overlapping resonances. The only natural prescription appears to be that of "adding phase-shifts" (strictly, multiplying Jost-functions); on applying it to the residual I = 0 dynamics the $\epsilon(900)$ and $\epsilon'(1250)$ effects coalesce into a single broad elastic resonance centered at or above 1100 MeV. This completes the tally of nonet candidates to whose hadronic decays a conventional SU(3) analysis is then applied. Some wider bearings of the resulting nonideal nonet structure are mentioned. (auth)

6452 ELECTROMAGNETIC GAUGE INVARIANCE, HADRON INTERACTIONS, AND THE NEW PARTICLE. de Urries, F. J.; Leon, J.; Tiemblo, A. (Laboratorio de Fisica de Particulas, Madrid). Nuovo Cim.; 29A: No. 3, 346-352(1 Oct 1975).

A generalization of the KLZ Lagrangian is developed. The hadronic symmetry $SU_4 \times U_1$ is broken in a gauge-invariant manner and the $\psi(3.105)$ included as the new neutral meson in the $15 \oplus 1$ multiplet. With independence of the quantum-number content one obtains $\Gamma_{\psi \to e^+e^-} = 1.27$ keV. Relations between quark structure and masses are discussed. (auth)

6453 MASSES OF BARYONS AND MESONS. Anderson, J. T. (Univ. of Maryland, College Park). Lett. Nuovo Cim.; 14: No. 5, 158-160(4 Oct 1975).

The masses of mesons and baryons are calculated. For this purpose use is made of the Lagrangian for a spinor and vector field as well as the Dirac equation. (JFP)

6454 SPIN AND POLARIZATION OF THE D AND E MESONS IN ANTI pp ANNIHILATIONS. Vullemin, V.; Gailloud, M.; Rosselet, P. (Univ., Lausanne, Switzerland). Lett. Nuovo Cim.; 14: No. 5, 165-170(4 Oct 1975).

The spin formalism is used to determine the spin-parity of the D and E mesons using five- and six-meson production in $\bar{p}p$ interactions at 1.50 to 2.05 GeV/c. It is concluded that the spin-1 hypothesis is strongly favored with respect to spin 0 for both the D and E mesons at confidence levels of 89 and 88%, respectively, and that spin 1 is slightly perferred to spin 2. (JFP)

6455 Psi PARTICLES AND DYONS. Schwinger, J. (Univ. of California, Los Angeles). Science; 188: No. 4195, 1300-1301 (27 Jun 1975).

A hypothetical magnetic model of matter provides a natural setting for the newly discovered psi particles. This supplements a phenomenological description of such particles that had appeared prior to their experimental recognition. (auth)

6456 OMEGA, RHO, AND A_2 EXCHANGES IN FORWARD TWO-BODY AMPLITUDES AT HIGH ENERGY. Bouquet, A.; Diu, B. (Univ., Paris). Nuovo Cim.; 29A: No. 3, 373-397 (1 Oct 1975).

The total cross section differences and forward differential cross sections for nondiffractive two-body processes (including the new FNAL data) are analyzed and compared with the corresponding Regge pole predictions. The method used is devised to detect possible deviations from these predictions: the data are analyzed step by step, independent quantities being fitted separately. All ω amplitudes are found in remarkable agreement with the Regge-pole model, with an intercept $\alpha_\omega = 0.44$ and residues verifying ω universality. The same is not always true for the isospin-one amplitudes, since difficulties arise in the πN system for the ρ and in the NN system for the A_2. These difficulties might be due to new physical effects. Anyway ρ-A_2

exchange degeneracy is strongly violated, at the level of both residues and the intercepts ($\alpha_\rho = 0.51$, $\alpha_{A_2} = 0.37$). The ρ residues are compatible with ρ universality, but there is a 20% breaking of the SU_3 prediction for the A_2 ones. (auth)

6457 MONTE CARLO GENERATION OF TWO BODY RESONANT STATES. Knop, R. E. (Florida State Univ., Tallahassee). Contract AT(40-1)-2509. J. Comput. Phys.; 18: No. 2, 115-118 (Jun 1975).

For Monte Carlo calculations of elementary particle processes, the transition rate integral can be written in terms of intermediate mass variables. Events generated in this way bear a weight factor consisting of the product of the squared transition amplitude and several two-body phase space factors. Importance sampling, using a Breit-Wigner density, can improve efficiency in the case that one or more mass variables of the transition density are well approximated by a Breit-Wigner resonance. With the further restriction that the resonance occurs close to threshold and decays to two final-state particles, the efficiency was improved by sampling a probability density which is the product of a Breit-Wigner density times the associated two-body phase space factor. (auth)

6458 INSTABILITY IN THE FRAMEWORK OF NONCOHERENT RESONANCE PRODUCTION ON NUCLEI. Pak, A. S.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 22: No. 1, 91-96(Jul 1975). (In Russian)

Considering of the effects of instability of ρ^0- and f^0-mesons in the reactions $\pi^{-(+)}A \to \rho^0(f_0)A'$ it is shown how to fit the data given in previous work to values expected for ρN- and fN-total cross sections. (auth)

6459 HADRON STRENGTHS, A SYSTEM OF HADRON SYMMETRY. Neeman, Y. (Tel-Aviv Univ., Israel). pp 375-387 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The discussion of hadron strengths covers two algebraic systems, the algebra of strengths, static SU(6) and $[U(6) \times U(6)]_p$, covariance and localization, Lorentz invariance and symmetry, the algebra of charges, and some applications. (JFP)

6460 DUAL RELATIVISTIC QUARK MODEL. Venturi, G. (Univ., Bologna). pp 451-465 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

An attempt is made to construct meromorphic dual models for scattering amplitudes such that at least the leading trajectory (trajectory containing the highest spin particles being exchanged at a particle pole) factorizes into a product of collinear U(6) invariant vertices (in the U(6) symmetry limit). These amplitudes would also incorporate the observed quark model particle spectrum on the leading trajectory. One may then hope to arrive at a unified high and low energy description of a scattering amplitude and render compatible the predictions of chiral and quark model symmetries. The $\pi\pi$ scattering amplitude is considered. (JFP)

6461 MESON-MESON SCATTERING: $\pi-\pi$ AND $\pi-K$. Froissart, M. (Physique des Particules Elementaires, Gif-sur-Yvette, France). pp 581-615 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

A brief review is given of the situation of present knowledge of $\pi\pi$ and πK scattering. The various theoretical ways in which these problems have been attacked, and the results compared with data from various origins are given. Finally, a certain number of problems which need further clarification and thinking are considered. (JFP)

6462 MESON SPECTROSCOPIC ANALYSIS IN THE HARMONIC OSCILLATOR QUARK MODEL. Lee, T. Y.; Chen-Tsai, C. T. (Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 12: No. 2, 98-108(Oct 1964).

The mass spectrum of mesons of quantum excitation $N \leq 2$ is consistently analyzed, via the harmonic oscillator quark model, in terms of the spin-spin, spin-orbit, and tensor potentials for the residual quark-antiquark interaction. Single harmonic oscillator states generally well describe the meson mass states, except for the lowest pseudoscalar octet mesons, which require a strong mixing of radial excitation states. The physical consequences of this effect are given. The SU(3) property of the spin-spin and spin-orbit potential strengths is found to obey the octet assumption quite well, but not the case for the tensor potential. (auth)

6463 ANALYSIS OF PCAC CONSTRAINTS IN A DISPERSIVE APPROACH TO OFF-MASS-SHELL $\pi\pi$ SCATTERING. Bonnier, B.; Johannesson, N. (CERN, Geneva). Nuovo Cim., A; 29A: No. 4, 565-577(21 Oct 1975).

A one-parameter set of $\pi\pi$ amplitudes fulfilling general on-shell constraints is extrapolated off the mass shell of one pion by means of the dispersive method suggested by Basdevant and Hayot. The ability of PCAC to restrict this class of amplitudes is investigated within some given criteria for the smoothness in the off-shell mass dependence. It is found in particular that the requirement of maximal smoothness selects some neighborhood of Weinberg's solution ($0 \leq a_0^0 \leq 0.4$). (auth)

6464 HOW ACCURATELY CAN THE KNY COUPLING CONSTANTS BE DETERMINED BY ANALYTIC CONTINUATION METHODS. Conti, A. (Univ., Lecce, Italy); Queen, N. M. Nuovo Cim., A; 29A: No. 4, 452-466(21 Oct 1975).

A comparison is made of three recently proposed « model independent » methods of analytically continuing a discrepancy function for $K^\pm p$ forward scattering. Each of these methods is applied to a set of simulated data points constructed from a model discrepancy function whose exact analytic continuation is known. It is found that none of the methods is capable of reproducing the value of the effective KNY coupling constant with the accuracy which has been claimed in recent publications. Moreover, in the case of conformal mapping methods, it is found that there is no practical advantage in mapping the energy plane into the « optimum » ellipse instead of into an appropriate circle, contrary to what has been suggested in the literature. (auth)

6465 EFFECTIVE POTENTIAL, INSTABILITIES, AND BOUND-STATE FORMATION. Fischler, W.; Gunzig, E.; Brout, R. (Univ. Libre, Brussels). Nuovo Cim., A; 29A: No. 4, 504-508 (21 Oct 1975).

It is shown that scalar QED causes attractive interaction among mesons in $O(e^4)$ which gives rise to bound-state formation. This is the physical origin of Coleman-Weinberg instability. The symmetry-breaking parameter φ_c corresponding to the induced minimum in the effective potential is related to the mass necessary to have a bound state of zero momentum. (auth)

6466 EXPERIMENTAL INVESTIGATION OF STRONG INTERACTION EFFECTS IN KAONIC AND ANTIPROTONIC ATOMS. Miller, J. P. Pittsburgh; Carnegie-Mellon Univ. (1975). 152p. University Microfilms Order No. 75-19,857.

Thesis (Ph. D.).

The effect of the strong interaction between the nucleus and negatively charged kaons and antiprotons in atomic orbit about this nucleus is investigated experimentally for a number of nuclei by observing the x-rays emitted during radiative transitions between atomic levels. In the present work, x-ray data are presented from kaonic atoms of Al, Si, Ni, Cu, Pb, and U and from antiprotonic N and O. Best-fit phenomenological potentials are given. It is found that the Ni data is in poor agreement with the predicted optical potential values, which may be an indictment of the model, or may reflect an anomaly in the nuclear surface matter distribution which is not displayed in the charge distribution as deduced from electron scattering and muonic atom data. A discussion is given as to the sensitivity of the data to surface density and their usefulness as a test of future models. (Diss. Abstr. Int., B)

Strong (Baryon No. = 1)

6467 (LBL-4222) pi N yields pi N AND KN yields KN LOW ENERGY DATA AND PARTIAL WAVE ANALYSES RECENT RESULTS AND NEW DIRECTIONS. Kelly, R. L. (California Univ., Berkeley (USA), Lawrence Berkeley Lab.). Jul 1975. Contract W-7405-ENG-48. 15p. (CONF-750729-4). Dep. NTIS $4.00.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

This review deals with pi N yields pi N and KN yields KN physics below about 3 GeV/c. An attempt is made to convey the state of the art, and to point out what appear to be promising directions for future research. The situation as of about one year ago is summarized in the 1974 Review of Particle Properties and in London conference talks so more recent developments are considered. A comprehensive survey of pi N yields pi N data between the DELTA region and 3 GeV/c is given. Problems associated with spin-rotation experiments are discussed, and the current pi N yields pi N partial wave analyses, I equals 1 and I equals 0 KN yields KN analyses, respectively, are considered. (auth)

6468 AMPLITUDE ANALYSIS OF THE REACTION $\pi^- p \to \rho^0 n$ AT THE MOMENTUM 4.5 GeV/c. Nilov, A. F.; Garanina, T. A.;

Guzhavin, V. M.; Kliger, G. K.; Lomkatsi, G. S.; Smolyankin, V. T. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 22: No. 1, 116-121(Jul 1975). (In Russian)

Results of the amplitude analysis of the reaction $\pi^- p \to \rho^0 n$ at momentum of 4.5 GeV/c are presented, and a qualitative comparison with the results of the analogous analysis at other momenta is fulfilled. (auth)

6469 TWO-PARTICLE CORRELATIONS IN INCLUSIVE AND SEMI-INCLUSIVE PION–NUCLEON REACTIONS AT p = 40 GeV/c. Alma Ata-Budapest-Bucharest-Warsaw-Dubna-Krakow-Moscow-Sofia-Tashkent-Tbilisi-Ulan Bator-Hanoi-Chandigar Collaboration. Yadern. Fiz.; 22: No. 1, 122-131(Jul 1975). (In Russian)

In framework of the inclusive approach the rapidity correlations (in terms of the correlation functions $R(y_1, y_2)$) and the distributions in differences of the azimuthal angles are investigated for various restrictions on the rapidities and transversal momenta of pions. The charater of the azimuthal distributions indicates a presence of long-range correlations. For channels with a definite number of secondary charged particles the distributions in the R-function values are obtained, that have a structure approaching the kinematical one with an increase of the multiplicity. Comparison of the obtained data with the phase-space calculations is carried out, using the multiperipheral model, as well as with the data from NAL and ISR. (auth)

6470 ASYMPTOTIC METHOD OF SOLVING OF THE EQUATIONS FOR PARTICLES WITH SPINS. Goloskokov, S. V.; Kuleshov, S. P.; Mitryushkin, V. K.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 24: No. 2, 147-154(Aug 1975). (In Russian).

On the basis of the operator method the procedure for finding the asymptotic solutions of the quantum theory equations for particles with spins in the high energy limit and fixed transfer momenta is developed. High energy amplitudes of the meson-baryon and baryon-baryon scatterings are found in the framework of the quasipotential approach. (auth)

6471 DEPENDENCE OF SLOPE ON MASS OF THE DIFFRACTIVELY PRODUCED $K^+\pi^+\pi^-$ SYSTEM IN THE REACTION $K^+p \to K^+\pi^+\pi^-p$ AT 4.97 GeV/c. Stopa, P. F. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., Ser. B; B6: No. 5, 683-688 (1975).

The method of data analysis proposed by Miettinen and Pirilä which eliminates kinematic reflections in the variation of the slope in momentum transfer distribution, as a function of diffractively produced effective mass, is applied to the reaction $K^+p \to K^+\pi^+\pi^-p$ at 4.97 GeV/c. It seems that for this reaction and at this energy, the strong rise of the slope parameter observed for low mass $K^+\pi^+\pi^-$ systems is mostly produced by kinematic effects. There is no proof that a slope-mass correlation must be explicitly present in the invariant matrix element. This does not confirm the results obtained by Miettinen and Pirilä for the reaction $pp \to n\pi^+p$ at 19 GeV/c. (auth)

6472 PARTIAL-WAVE ANALYSIS OF THE THREE-PARTICLE PROTON DISSOCIATION. Kotanski, A. (Jagellonian Univ., Krakow). Acta Phys. Pol., Ser. B; B6: No. 3, 397-407 (1975).

The Illinois partial wave analysis program was modified to study the dissociation of the proton into proton and two mesons. The formalism used in this modification is described in detail, and a geometrical interpretation of all spin rotations and couplings is given. (auth)

6473 LOW-ENERGY πN SCATTERING IN THE HARD PION CURRENT ALGEBRA MODEL. Radutskii, G. M. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 139-141(1975). (In Russian).

In the hard pion model the amplitude $A^{(+)}(\nu,t)$ of πN scattering was calculated at low energies. In contrast to other known models it was possible to obtain proof of the amplitude dependence on t in the form of a $(t - 2m_\pi^2)$. The coefficients at powers above the first are close to zero. Reasonable agreement with experiment was obtained. (tr-auth)

6474 ANTIPROTON PHYSICS. Muirhead, H. (Univ. of Liverpool). pp 617-691 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of submuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The review of antiproton physics is mainly concerned with processes unique to antiproton physics. The systematics of the annihilation process, formation experiments, and the production of resonances in annihilations are discussed. (JFP)

6475 GEOMETRICAL SCALING, QUARKS, AND THE POMERON. Dias de Deus, J. (Univ. of Copenhagen). Acta Phys. Pol., Ser. B; B6: No. 4, 613-624(1975).

From quark model additivity applied in the impact parameter plane to the inelastic overlap function one obtains a kind of scale invariant factorizable Pomeron. Quarks themselves are seen as behaving asymptotically like extended objects (quark pancakes), cross-sections and multiplicities being related to their overlap in a high energy collision. Predictions, which can be tested soon at NAL, are given for overlap functions, cross sections, the ratio σ^{el}/σ^{tot} in the case of various reactions. Universality features of multiplicity distributions are explained in a natural way, and an attempt is made to compute the modifications coming from the leading particle effect. (auth)

6476 FURTHER RESULTS ON THE REACTION $\pi^- + p \to e^+ + e^- + n$. Bietti, A.; Petrarca, S. (Univ., Rome). Lett. Nuovo Cim.; 13: No. 14, 539-545(2 Aug 1975).

A new pion photoproduction multipole analysis has been made for the reaction $\pi^- + p \to e^+ + e^- + n$ and incorporates a considerable amount of new data over a large energy range between threshold and the total center of mass energy of 2.0 GeV. Estimates for the coefficients of the form factors are tabulated for different form factor equations. (8 tables) (SDF)

Strong (Baryon No. ≥ 2)

6477 (IC-75/67) MULTIPARTICLE PRODUCTION ON NUCLEI: THEORY. Bertocchi, L. (International Centre for Theoretical Physics, Trieste (Italy)). 1975. 28p. (CONF-750631-13). Dep. NTIS (US Sales Only) $4.50.

From 6th international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

Models for multiparticle production at very high energies on nuclear targets are reviewed. In particular, the predictions following from the space-time description of the multiperipheral model and of the Energy Flux Model are discussed. Other models, as well as the predictions for production in nucleus-nucleus collisions are briefly treated. (19 figures, 40 references) (auth)

6478 (JINR-E2-9137) SPACE-TIME DEVELOPMENT OF THE MULTI-PARTICLE PRODUCTION AND HADRON NUCLEUS INTERACTIONS AT HIGH ENERGIES. Kalinkin, B. N.; Shmonin, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 26p. (CONF-750659-2). Dep. NTIS (US Sales Only) $5.00.

From 4th international seminar on high energy physics problems, many-body processes; Dubna, USSR (Jun 1975).

The problems which have arisen recently in studying the multiple production processes in nuclear matter are considered. It is shown that their solution is closely connected with concrete development of these processes in an elementary act. This makes it possible to point out the most realistic models of multiple production as well as to obtain additional information necessary for their improvement. (auth)

6479 ANALYSIS OF THE PROTON–PROTON INTERACTION AT LOW ENERGIES. Naisse, J. P. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. R. Belg.; 60: No. 5, 1391-1411(Dec 1974). (In French)

The recent analysis developed by Arndt, Hackman, and Roper on the basis of high precision data on proton–proton scattering is examined critically from the viewpoint of the treatment of interference effects between electromagnetic and hadronic interactions at low energies taking into account normalization ambiguities as well as the constraints imposed by measurements carried out in the neighborhood of an energy corresponding to the maximal interference and omitted in the previous study. (tr-auth)

6480 LARGE MOMENTUM TRANSFER CORRECTIONS TO THE GLAUBER MODEL IN NONRELATIVISTIC EIKONAL EXPANSION. Rek, Z. J. (Deutsches Elektronen-Synchrotron DESY, Hamburg). Acta Phys. Pol., Ser. B; B6: No. 5, 689-702(1975).

Corrections to the Glauber model for hadron-deuteron scattering in the realm of nonrelativistic eikonal expansion are expressed through two-body scattering amplitudes. Numerical calculations including off-shell effects are carried out, and the comparison with experimental data is given for elastic π^-d scattering at 9 GeV/c. Dependence of the relative values of corrections on parameters of input amplitudes is checked. It turns out that this type of corrections does not exceed 22% at the largest momentum transfer measured, $t \approx -2(\text{GeV/c})^2$. (auth)

6481 CORRELATIONS BETWEEN MISSING MASS AND MULTIPLICITY IN PROTON–PROTON COLLISIONS. Hogaasen, H.; Myrheim, J. (Univ. of Oslo). Acta Phys. Pol., Ser. B; B6: No. 3, 379-386(1975).

It is shown how correlations between missing mass and multiplicity in high energy reactions are easily explained by fireball production, and one tries in a simple manner to illustrate the properties of the fireballs. (auth)

6482 COMMENT ON THE SHAPES OF MULTIPLICITY DISTRIBUTIONS IN pp COLLISIONS. Ferbel, T. (Univ. of Rochester, NY). Acta Phys. Pol., Ser. B; B6: No. 5, 703-705 (1975).

The shapes of multiplicity spectra observed in inelastic pp collisions at high energies are discussed. It is found that a recent observation, which claims that the negative-particle multiplicity is consistent with a Poisson distribution for high multiplicities, is not valid at the highest Fermilab energies. (auth)

Particle Invariance Principles and Symmetries

General

6483 RECURSIVE METHOD FOR THE REPRESENTATION MATRICES OF SU(n). Majumdar, S. D.; Guha, D. K. (India Inst. of Technology, Kharagpur). Acta Phys. Pol., Ser. B; B6: No. 3, 347-355(1975).

A simple procedure is described for expressing the generators of SU(n) as differential operators in the parameters of the group. It is then shown how recursion relations for the matrix elements of the "boost operator" leading from SU(n − 1) to SU(n) can be obtained by treating the representation functions as basis functions and operating on them by the differential operators. The matrix elements of the "boost" appear in the present theory as solutions of ordinary differential equations. The operators for SU(3) and SU(4) are constructed, and some recursion relations and special matrix elements are derived by way of illustration. (auth)

6484 REPRESENTATIONS OF CONFORMAL SYMMETRY BY PARA-BOSE OPERATORS AND SUPERSYMMETRY. Castell, L. (Max-Planck Inst. fuer Erforschung, Starnberg, Ger.). Nuovo Cim., A; 29A: No. 4, 445-451(21 Oct 1975).

The algebra of Bose operators is used to construct a representation of the Lie algebra of the central extension of the inhomogeneous $SU_{2,2}$. This leads to a mass-zero representation, which has a close connection with twistor quantization. The representation of $SU_{2,2}$ by para-Bose operators leads to massive representations, whose connection with the supersymmetry algebra is exhibited. (auth)

Applications (Electromagnetic and Weak)

6485 EXCEPTIONAL REALIZATIONS OF THE LORENTZ GROUP: SUPERSYMMETRIES AND LEPTONS. Gunaydin, M. (Scuolo Normale Superiore, Pisa, Italy). Nuovo Cim., A; 29A: No. 4, 467-503(21 Oct 1975).

Exceptional realizations of the Lorentz group are given via the exceptional Jordan algebra of Jordon, von Neumann and Wigner. The exceptional $SL_{2,c}$ multiplets generate an intrinsically nonassociative algebra and have built in non-Abelian charge space properties. Considering these multiplets as the basis of a superspace it is shown how to give realizations of exceptional supersymmetry groups which incorporate important charge-space groups in a nontrivial way and which are different from the usual Clifford algebraic supersymmetry groups. Possible applications to the leptonic world are indicated. (auth)

Applications (Strong)

6486 ARE THERE FOUR PSI-PARTICLES. Kalman, C. S. (Concordia Univ., Montreal). Lett. Nuovo Cim.; 14: No. 4, 115-118(27 Sep 1975).

The masses of the known ψ are used to predict further ψ's. Using the suggestion of the charm symmetry group SU(4), the masses of other meson resonances are predicted. (JFP)

6487 REPRESENTATION OF $SU_3 \times SU_3$ CHIRAL ALGEBRA FOR BARYONS. Buccella, F. (Univ., Rome). pp 325-329 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

For the study of a representation of SU(3) × SU(3) chiral algebra for baryons the possibility to obey with a given axial charge the equation $[Q_5^{+12}, [Q_5^{+12}, m^2]] = 0$ connected to the absence of I = 2 exchanges with $\alpha Co \geq 0$ is treated. A pictorial image of the scheme presented is given by the suggestion of to two or more quarks, bound together in a symmetric way, and a valence quark, which is active in the scattering process. (JFP)

6488 SPIN-ZERO MESONS IN THE FRAMEWORK OF BROKEN CHIRAL $SU_3 \times SU_3$. Rodenberg, R. (Technische Hochschule, Aachen, Ger.). pp 389-437 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The Furlan-Fubini collinear parametrization method of dispersive sum rules for N-point functions are used to discuss some properties of the spin-zero mesons in the framework of broken chiral SU(3) × SU(3) by means of field-current identities. Included are the set of commutators as the basis for the current and field-algebraic description of spin-zero mesons, the mesonic 3-, 2-, and 4-point functions, the influence of the (K, π)-continuum on the previous results, and (K, π)-scattering and the K_{l3} decay parameters. (JFP)

Scattering Theory

Refer also to abstract 6617.

6489 (RL-75-123) REGGE PHENOMENOLOGY OF INCLUSIVE PROCESSES. Roy, D. P. (Science Research Council, Chilton, (UK). Rutherford Lab.). Jul 1975. 23p. (CONF-750742-2). Dep. NTIS (US Sales Only) $4.25.

From 6th international colloquium on multiparticle dynamics; Oxford, UK (Jul 1975).

The present state of the Regge and duality approach to inclusive reactions is reviewed. (auth)

6490 GAUGE VARIATION OF PROPER VERTICES IN LOCAL GAUGE THEORIES. (Univ., Padua). Lett. Nuovo Cim.; 14: No. 5, 171-176(4 Oct 1975).

An analysis of the gauge variation of one-particle irreducible vertex functions is presented; and as a by-product a much simpler and more direct proof of the invariance of the S matrix is obtained. (JFP)

6491 CLASSICAL LIMIT OF THE SCATTERING MATRIX IN QUANTUM FIELD THEORY. Tyupkin, Yu. S.; Fateev, V. A.; Shvarts, A. S. (Moscow Engineering-Physics Inst.). Dokl. Akad. Nauk SSSR; 221: No. 1, 70-73(1975). (In Russian)

The purpose of this study is to find the relations between particlelike solutions of classical, nonlinear, translational-invariant equations and the particles in quantum field theory, and also between scattering in the quantum and classical cases. These relations are investigated, in particular for a precisely solvable model, which is the nonlinear, single-dimensional Schroedinger equation with a functional of a Hamiltonian. (SJR)

6492 DISCONTINUITY FORMULA IN KADYSHEVSKY'S FORMALISM. Brzezowski, S. (Jagellonian Univ., Krakow). Acta Phys. Pol., Ser. B; B6: No. 3, 357-364(1975).

The problem of the discontinuities of the Feynman amplitudes is discussed. Kadyshevsky's formalism is used to obtain the Cutkosky formula. (auth)

6493 EXCHANGE INTERACTION IN SCATTERING ON THE BOUND STATE. Arkhipov, A. A.; Savrin, V. I. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 24: No. 3, 303-314(Sep 1975). (In Russian).

In the framework of the one-time formulation of three-body problem in quantum field theory, the problem of scattering on the bound state is considered for the case when one of the incident particles is identical to one of the particles of the target. It is shown that due to the identical nature of these particles the exchange interaction takes place which can be connected with the mechanism of scattering on the bound state with the rearrangement. (auth)

6494 ANALYSIS OF SCATTERING AMPLITUDES AS A FUNCTION OF THE FORM OF OVERLAP FUNCTIONS. Azimov, S. A.; Arushanov, G. G.; Pirmatov, I. I. (Tashkent State Univ.). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 39-44(1975). (In Russian).

On the basis of unitarity conditions the behavior of the elastic scattering amplitudes was studied as a function of the form of the overlap functions and phase displacement. (tr-auth)

6495 APPROXIMATE SOLUTION OF THE VARIABLE PHASE EQUATION FOR SINGULAR POTENTIALS. Atansov, A. A. (Univ., Plovdiv, Bulgaria). Teor. Mat. Fiz.; 24: No. 3, 400-405(Sep 1975). (In Russian).

A variable phase equation is obtained which is well suited for the problems with singular potentials. The method of formal series for solving this phase equation is applied. The solution is represented as a ratio of two Volterra series. (auth)

6496 THEORY OF REDUCED DENSITY MATRICES. Kryachko, E. S. (Inst. of Theoretical Physics, Kiev.). Teor. Mat. Fiz.; 24: No. 3, 406-411(Sep 1975). (In Russian).

Applications of the expansion of the symmetric group S_N on the left cosets of the subgroup $S_n \times S_m$ $(n + m = N)$ to the reduced density matrices theory are considered. (auth)

6497 CONTINUATION OF SCATTERING AMPLITUDE INTO THE CROSSED CHANNEL IN THE CASE OF INCREASING TOTAL CROSS SECTION. Tyurin, N. E.; Khrustalev, O. A. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 24: No. 3, 291-302(Sep 1975). (In Russian).

A way of connecting the direct channel and the annihilation channel is suggested, which is based on analytical continuation of generalized reaction matrix. (auth)

6498 REGGE POLES AND DUALITY. Phillips, R. J. N. (Rutherford Lab., Chilton, Eng.). pp 53-101 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori (1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The lectures on Regge poles and duality cover poles, cuts, amplitude analyses, 1972 models, and inclusive reactions are presented. (JFP)

6499 DAMA FOR MESON–BARYON SCATTERING. Jenkovszky, L. L.; Kobylinsky, N. A.; Prognimak, A. B. (Inst. for Theoretical Physics, Kiev). Ann. Phys. (Leipzig); 32: No. 2, 81-92(1975).

The generalization of DAMA (dual amplitude with Mandelstam analyticity) to the case of meson-baryon scattering is studied. To this end trajectories with left-hand cut are introduced in the model under consideration. Threshold and asymptotic bounds on these trajectories are obtained. Combinations suitable for boson-fermion and fermion-fermion amplitudes are constructed. A specific example, namely πN-scattering, is considered, for which dual models of invariant amplitudes are constructed. (auth)

6500 DUAL POMERON AMPLITUDE WITH EXTERNAL SPIN PARTICLES. Ebert, D.; Otto, H. J. (Univ., Berlin). Ann. Phys. (Leipzig); 32: No. 1, 47-60(1975).

On the basis of the operator-formulation of the conventional dual resonance model one derives an expression for the one-loop Pomeron exchange amplitude with four external excited particles lying on the parent Regge trajectory. Evaluation of the high energy behavior leads to the definition of spin-spin-Pomeron form factors. There is a leading Pomeron contribution only if the sum of external spins is even. The dual Pomeron does not exhibit any helicity conservation properties except for s-channel forward scattering. The extension to multiloop amplitudes is briefly discussed. (auth)

6501 OPTIMIZATION OF COLLISION AMPLITUDES. Eden, R. J. (Cavendish Lab., Cambridge, Eng.). Acta Phys. Austriaca; 40: No. 1, 15-26(1974).

An outline review is given of optimization methods applied to collision amplitudes. An illustrative selection of results is described and some unsolved problems are discussed. (auth)

6502 PROOF OF THE UNITARITY OF THE S-MATRIX. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 25: No. 1, 20-29(Oct 1975). (In Russian).

Formal proof of the unitarity of the S-matrix in the functional form is given. The following assertion is proved: if in the perturbation theory the intermediate regularization is introduced by means of the propagators of virtual particles and the finite limit when the regularization is taken off, exists, then the limiting S-matrix is unitary. (auth)

6503 ONE METHOD FOR THE DETERMINATION OF EIGENVALUES OF S-MATRIX FOR SCATTERING IN A SINGULAR SPHERICAL–SYMMETRIC POTENTIAL FIELD. Ivanov, K. I. (Univ., Plovdiv, Bulgaria). C. R. Acad. Bulg. Sci.; 28: No. 5, 589-592(1975).

A method, similar to the phase-function method, is proposed in which the eigenvalues of the S matrix and the Jost functions are defined by finding suitable solutions of systems of ordinary differential equations of the first order. The method is developed for nonrelativistic scattering, but it can also be generalized for relativistic quasi-potential scattering. A spin particle with mass $\frac{1}{2}$ in a spherical-symmetric potential field is examined. The method can also be applied when the potential contains a Coulomb term. (RWR)

6504 HIGH ENERGY BEHAVIOR OF NONPLANAR AND PLANAR DUAL MULTILOOP AMPLITUDES. Dorn, H.; Ebert, D.; Otto, H. J. (Humboldt Univ., Berlin). Acta Phys. Pol., Ser. B; B6: No. 4, 599-612(1975).

Multi-loop four-point amplitudes constructed from iteration of non planar or planar orientable self-energy operators are studied in the asymptotic limit of large s. Expected factorization properties to sum up the leading contributions of multi-loop graphs of arbitrary order are found. This leads to the definition of renormalized Pomeron and Regge trajectories. (auth)

PHYSICS (LOW-TEMPERATURE)

Superconductivity

Refer also to abstracts 5955–5957, 5980, 5983–5986, 6004, 6016, 6017, 6019–6026, 6030–6035, 6049, 6050, 6066, 6068, 6069, and 6655.

6505 INFLUENCE OF EXCITATION DRAGGING BY PHONONS ON THE THERMAL CONDUCTIVITY OF PURE SUPERCONDUCTORS. Gurevich, L. E.; Krylov, E. T. (Leningrad Physical-Technical Inst.). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1337-1348(Apr 1975). (In Russian)

Dragging of excitations by phonons and its contribution to the thermal conductivity of pure superconductors are investigated. The thermal conductivity mechanism is compared quantitatively with the familiar mechanisms. It is shown that at temperatures close to the critical the thermal conductivity is determined by the excitation flux, the dominant role in the flux being played by energy exchange between the excitations and phonons. Exchange of momentum between excitations and phonons also contributes to the thermal conductivity, but the contribution is negligible at all temperatures. However, at temperatures which are from 0.3 to 0.7 of the critical temperature, phonons and dragging of excitations by phonons contribute significantly to the thermal conductivity. Qualitative agreement between the theory and experiments is observed in superconducting lead and mercury. An experimental means of observing the effect of excitation dragging by phonons on thermal conductivity is mentioned. (auth)

6506 U. H. F. IMPEDANCE OF SUPERCONDUCTORS IN THE MIXED STATE. Kupriyanov, M. Yu.; Likharev, K. K. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 4, 1506-1513(Apr 1975). (In Russian)

The uhf impedance of superconductors of the second kind ($\kappa \gg 1$) is calculated at $T \approx T_c$. Analytic expressions are obtained for the impedance for arbitrary ultrahigh frequencies of the external action when $H \sim H_{c2}$ and for the complete range of variation of H in the limit of low $\omega\tau_1 \ll 1$ and high $\omega\tau_1 \gg 1$ frequencies of the external action (τ_1 is the current relaxation time). An expression for the effective vortex mass is found. (auth)

6507 THEORY OF THE ELECTRIC CURRENT TRANSMISSION COEFFICIENT IN THE SUPERCONDUCTOR-INSULATOR-SUPERCONDUCTOR GEOMETRY. Navani, R. Washington, DC; Georgetown Univ. (1974). 180p. University Microfilms Order No. 75-14,877.

Thesis (Ph. D.).

Tunneling in the superconductor-insulator-superconductor (S'-I-S) geometry, where the two superconductors are not necessarily the same, is studied theoretically. Two different models of the S'-I-S geometry - which we call the "initial model" and the "improved model" - are discussed. For the initial model the potential barrier is flat. In the improved model, however, the differing material properties of the three regions - S', I, and S - are taken into account in an approximate fashion. In addition, applied, contact, and image potentials in the insulator are included. The solid state material properties that are taken to be different are the effective electronic masses in the three regions and the Fermi energies in the two superconductors. The quasiparticle wave functions in the S', I, and S regions are determined for both models as solutions to the Bogoliubov-de Gennes equations. The electric current transmission coefficients (also the reflection coefficient for the initial model) are derived and their behavior is extensively analyzed. Their forms in the thick barrier limit - where L is greater than or equal to 5 A - are related to the BCS densities of states. The tunneling current density is found to depend strongly on the tunneling angle. A relation between the angular position of the tunneling current peak and the barrier thickness is given. Finally, it is shown that the choice of insulator material effects the tunneling current, and the effect is greater the thicker the insulating film. (auth)

6508 KINETICS OF THE DESTRUCTION OF SUPERCONDUCTIVITY BY A CURRENT LESS THAN SILSBEE'S CRITICAL VALUE. Posada, E.; Rinderer, L. (Univ. Lausanne, Switzerland). J. Low Temp. Phys.; 21: No. 3/4, 223-243(Nov 1975).

An experimental study of the destruction of superconductivity in cylindrical tin wires by currents less than Silsbee's critical value is presented. The experiments show that in this case the average motion of the boundary between the superconducting and nonsuperconducting regions takes place longitudinally at a constant velocity. The conditions that must be fulfilled in order to observe this type of propagation are discussed, and calculations of the time required to start the transition and of the velocity of the boundary are given. (11 figures) (auth)

6509 ELECTRODYNAMICS OF SUPERCONDUCTING MAGNETIC ALLOYS IN THE WEAK COUPLING THEORY. Lam, J. (Dikewood Industries, Inc., Albuquerque, NM). J. Low Temp. Phys.; 21: No. 3/4, 415-429(Nov 1975).

The linear response of a superconducting magnetic alloy to a weak, transverse electromagnetic field is studied in the weak coupling theory of the alloy developed in a previous publication. By weak coupling is here meant that the scattering of the conduction electrons by the magnetic impurities is weak compared to the attractive, superconducting pairing interaction. An expression is derived for the wave-vector- and frequency-dependent transverse conductivity, in the approximation in which only single-particle excitations are included. The result is applied to calculate the dependence of various electromagnetic properties on the temperature and the impurity concentration, such as the magnetic field penetration depths and electromagnetic absorption. Calculations are also presented for the electronic spin susceptibility. The outstanding feature of the results is the finite density of electronic states at the Fermi level. (5 figures) (auth)

6510 KINETICS OF THE CURRENT-INDUCED PHASE TRANSITION IN TYPE I SUPERCONDUCTING WIRES. Wiederick, H. D.; Mukherjee, B. K.; Baird, D. C. (Royal Military Coll. of Canada, Kingston, Ont.). J. Low Temp. Phys.; 21: No. 3/4, 257-269(Nov 1975).

The time required for the destruction of type I superconductivity in high purity indium wires by a current greater than the critical current has been measured. The results are not in agreement with theoretical treatments presented by Pippard and by Rothen and Bestgen and we suggest possible inadequacies in the theoretical models. (7 figures) (auth)

6511 PEIERLS INSTABILITY IN PSEUDO-ONE-DIMENSIONAL CONDUCTORS. Leung, M. C. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev., B; 11: No. 11, 4272-4277(1 Jun 1975).

An investigation was made of the properties of pseudo-one-dimensional systems which exhibit Peierls instability at T/sub c/ (mu), where mu is the Fermi energy as measured from the middle of a conduction band. It is shown that, except at mu equals 0 or |mu| much greater than T, the giant Kohn anomalies of the phonon spectrum do not occur at 2k/sub F/. For |mu| much less than W, where 2W is the bandwidth, T/sub c/(mu) decreases as |mu| increases, and, for W much greater than |mu| much greater than T, T/sub c/(mu)/T/sub c/(0) equals T/sub c/(0)/2.26|mu|. As |mu| further increases towards W, the decrease of T/sub c/(mu) towards zero need not in general be monotonic. The neutron scattering differential cross section shows a peak with magnitude proportional to $(T-T/\text{sub c/})^{-1}$. (auth)

6512 PROCEEDINGS OF THE FIFTH INTERNATIONAL CRYOGENIC ENGINEERING CONFERENCE, KYOTO, JAPAN, MAY 7–10, 1974. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974). 584p. (CONF-740509-). Pounds 35.00.

Separate abstracts are given for 137 papers, 136 appearing in Nuclear Science Abstracts and 11 appearing in ERDA Research Abstracts. Five additional items were indexed for the ERDA data base. (SDF)

For abstracts of individual papers see: 5378, 5457–5547, 5573, 5956, 6019–6035, 6050, 6066–6069, 6103–6108, 6121, 6123, 6129, 6323–6325, 6329, 6513–6518, and 6589.

6513 FLUX FLOW IN THE INTERMEDIATE STATE OF TYPE I SUPERCONDUCTORS. Laeng, P.; Rinderer, L. (Univ., Lausanne, Switzerland). pp 118 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Resistance measurements have been illustrated in the intermediate state with a motion picture showing by means of a high resolution magneto-optical technique the behavior of the domain structure in a current-carrying lead slab subjected to a transverse magnetic field. In the present geometry, as the intensity of the external magnetic field is decreased, we observed gradual change from a static lamellar structure to a dynamic flux tube

structure analogous in some respects to that encountered in the mixed state of type II superconductors. Domain velocity measurements are in agreement with the existing theories. (auth)

6514 DISCUSSION ON THEORIES OF MAGNETIC INSTABILITY IN A HARD SUPERCONDUCTOR. Koyama, K. (Electrotechnical Lab., Tokyo). pp 137-140 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A new magnetic instability theory for a superconducting composite conductor is presented and the relation among the former instability theories, i.e. adiabatic, cryogenic and dynamic, is discussed from the point of view of our theory. Then the optimum current density of the composite conductor is derived from our stability criterion. (3 figures) (auth)

6515 SUPERCONDUCTING-TO-NORMAL TRANSITION OF TYPE I SUPERCONDUCTORS BY A RECTANGULAR CURRENT PULSE. Shibuya, Y. (Kyushu Univ., Fukuoka); Koga, S.; Onuki, A. pp 141-142 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Theoretical calculations and experiments on the superconducting-to-normal transition of type I superconductors subjected to a rectangular current pulse are described. Reasonable agreement is seen with the result obtained by Rothen and Bestgen. (1 figure) (auth)

6516 STABILITY OF HOLLOW SUPERCONDUCTOR WITH STEADY HEAT INPUT. Todoriki, I.; Agatsuma, K. (Electrotechnical Lab., Tokyo). pp 420-424 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

A calculation method is described for determining the steady-state temperature profile of a hollow superconductor, part of which is in the state of flux flow by heating. From the temperature profile the stability of the hollow superconductor can be determined. The criterion for stable operation is that the temperature of the superconductor at the downstream end does not exceed $(1-I/I_c)$. The stability is found to be strongly influenced not only by Stekly's parameter but also by a flow parameter, which is inversely proportional to $(Re)^{0.8}$. (auth)

6517 STABILITY OF INTERNALLY COOLED SUPERCONDUCTOR. Tsukamoto, O. (Yokohama National Univ., Japan). pp 425-428 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The stability characteristics of a hollow conductor are quite different from those of a conventional immersion-cooled superconductor, because the temperature of the coolant rises while the coolant cools the dissipating part of the hollow conductor. In this paper, we analyse the propagation characteristics of a normal region in a hollow conductor. Then we investigate the stationary stability and the growth rate of a normal region. (auth)

6518 INVESTIGATION ON THE STABILITY OF A LOCALLY HEATED HOLLOW SUPERCONDUCTOR. Mori, Y. (Tokyo Inst. of Tech.); Inai, N. pp 429-432 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

Investigations have been made on the stability of a hollow superconductor which undergoes local Joule heating by bypassing current in the conductor substrate. In order to know the precise nature of the temperature growth or decay characteristics, a numerical analysis is made over the system of the one-dimensional energy equation of coolant helium gas and the conduction equation of conductor substrate. The analysis shows that there is a critical inner heating value below which the hollow superconductor is stable, and above which it is unstable and propagation of a normal zone is seen. Stability consideration may be made in terms of dimensionless parameters included in the system of equations. Consideration as to the design of a stable hollow superconductor is made. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

6519 (CNEA-393) NEUTRON THERMALIZATION IN LIGHT WATER. Spectrum Measurements and Calculations. Abbate, M. J.; Lolich, J. V. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1975. 17p. (In Spanish). Dep. NTIS (US Sales Only) $4.00.

Investigations related to neutron thermalization in light water have been made. Neutron spectra under quasi-infinite-medium conditions have been measured by the time-of-flight technique and calculations were performed with different codes. Through the use of improved experimental techniques and the best known calculational techniques available, the known discrepancies between experimental and theoretical values were lowered 40% to 16%. The present disagreement is believed to be due to the scattering model used (ENDF-GA-SKET, based on the modified Haywood II frequency spectra), that shows to be very satisfactory for poisoned light water cases. Moreover, previous experiments were completed and differential, integral and pulse-source experimental techniques were improved. Also a second step of a neutron and reactor calculation system was completed. (8 figures) (auth)

6520 (IEA-368) TWO-GROUP MILNE PROBLEM: A NUMERICAL STUDY OF THE EFFECT OF SCATTERING ANISOTROPY. Ishiguro, Y.; Jorge, E. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Dec 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The Milne problem in two group neutron-transport theory for linearly anisotropic scattering is solved in terms of H-matrices using half-range orthogonality relations of the eigenfunctions. The effect of scattering anisotropy is studied numerically using Metcalf and Zweifel's isotropic scattering data set for light water and considering the anisotropic part of the transfer matrix given by B = CP where C is the isotropic part and P is 2 × 2 matrix. (auth)

6521 (IEA-370) HALF-RANGE ORTHOGONALITY THEOREM FOR THERMAL NEUTRON TRANSPORT. Ishiguro, Y. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1975. 7p. Dep. NTIS (US Sales Only) $4.00.

It is shown that the eigenfunctions of the energy dependent transport equation with isotropic scattering degenerate kernel have a half-range orthogonality property. Adjoint functions are expressed in terms of the H matrix introduced by Pahor. (auth)

6522 PHENOMENOLOGICAL INTERPRETATION OF THE ADJOINT NEUTRON TRANSPORT EQUATION. De Matteis, A. (CNEN, Bologna). Meccanica; 9: No. 3, 162-164(1974).

Models for interpreting the steady state adjoint neutron transport equation in terms of elementary events occurring to particles are constructed and discussed. These models, which may serve as a basis for the Monte Carlo simulation, are characterized by defining appropriate cross sections. Adjoint neutron problems are then related to direct transport problems concerning particles subject to events of absorption or of production of secondaries. (auth)

6523 THERMAL NEUTRON SCATTERING. Chen, Y. (Inst. of Atomic Energy, Peking). Wu-li; 4: No. 2, 96-101(18 Apr 1975). (In Chinese)

Application of thermal neutron scattering to statical and dynamical structural research is a border subject of definite characteristics. For more than ten years, the scope of its research has been constantly expanding. From its implications with such subjects as solids, liquids, magnetism, low temperature, chemistry and others, definite results have been obtained on fundamental theories and practical applications, and have drawn international attention to the advance of applied nuclear physics. Based on the principle of "Foreign for Chinese Utilization", this new-born subject is briefly introduced. The first and second sections explain its fundamental principles and its relation to the neighboring subjects, and the third and fourth sections introduce the inelastic scattering measuring techniques, and its advance in each of the above-mentioned subjects. (JPRS)

6524 MATHEMATICAL MODELS OF THE NEUTRONS SLOWING-DOWN IN MULTIELEMENT MEDIUM. Kozachok, I. A. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 7, 588-592(Jul 1975). (In Ukrainian).

Mathematical models used for an approximate description of the neutron slowing down process, with their accuracy and the field of application depending on the composition and hydrogen content of a moderator are dealt with. A quasi-hydrogen model is suggested permitting one to realize a single approach to the description of neutron slowing-down in the medium of arbitrary composition. No restriction is superimposed on the hydrogen content in the model. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstract 6269.

6525 (CRN/PN-75-15) E0 DECAY OF THE TWO FIRST EXCITED 0^+ STATES IN ^{18}O. Souw, K. H.; Adloff, J. C.; Disdier, D.; Chevallier, P. (Centre National de la Recherche Scientifique, 67- Strasbourg (France). Centre de Recherches Nucleaires). 1975. 21p. Dep. NTIS (US Sales Only) $4.25.

The reaction $^{19}F(t,\alpha)^{18}O$ has been used to study the E0 π-decays of the ^{18}O(3.63-MeV, 0^+) and ^{18}O(5.33-MeV, 0^+) states to the ground state. The E0 branching ratios Γ_π/Γ were measured to be respectively $(3.0 \pm 0.6) \times 10^{-3}$ and $\leq 2.3 \times 10^{-3}$. When these values are combined with the available lifetimes of these states, E0 matrix elements $\langle M \rangle = (6.0 \pm 0.7)\text{fm}^2$ (^{18}O(3.63 MeV)) and $\leq 4.5\ \text{fm}^2$ (^{18}O(5.33 MeV)) are obtained. The properties of these states are compared to the theoretical predictions. (6 figures, 1 table) (auth)

6526 ANALYSIS OF ELASTIC SCATTERING OF α PARTICLES OFF ^6Li IN FRAMEWORK OF THE K-MATRIX APPROACH AND OF THE PADE APPROXIMATION AND THE DETERMINATION OF THE COUPLING CONSTANT FOR THE VERTEX $^6Li \rightarrow \alpha + d$. Baryshnikov, A. G.; Blokhintsev, L. D. (Moscow State Univ.). Yadern. Fiz.; 22: No. 1, 104-109(Jul 1975). (In Russian)

It is shown that the elastic α^6Li scattering at low energies may be reasonably described if one takes the deuteron-exchange one-pole Feynman graph as the reaction K matrix. Comparison of the theory with the experiment provides with the quantity 0.050 f for the coupling constant G^2, corresponding to the vertex $^6Li \rightarrow \alpha + d$. The calculations are also carried out for an account of the contribution to the K matrix from the Feynman box graph, describing two-deuteron exchange, and from the loop graph, describing an exchange of unbounded proton-neutron system. The calculations in the Padé approximation are also carried out. The results slightly deviate from the one-pole approximation for the K matrix and the extracted value of the constant G^2 is unchanged. (auth)

6527 EFFECT OF CENTER-OF-MASS MOTION IN QUASI-ELASTIC ELECTRON SCATTERING ON ^4He NUCLEUS. Dementii, S. V.; Ogurtsov, V. I.; Shebeko, A. V.; Afanas'ev, N. G. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 22: No. 1, 13-20 (Jul 1975). (In Russian)

Experimental results are presented on investigation of inelastic scattering of electrons with energies 800 to 1200 MeV at the angles 16 to 40° on the nucleus ^4He. It is shown that the experimental cross sections, measured in region of the quasielastic maximum may be brought in agreement with the results on elastic scattering on the nucleus ^4He in framework of the shell model, only if the correction due to the center-of-mass motion is taken into account. Analysis of the obtained results enables one to conclude that the effect of the center-of-mass motion results in narrowing (as compared with predictions of the shell model) of the nuclear density, as well as of the momentum distribution of the internal nucleons. (auth)

6528 $A\Sigma$ CONVERSION IN $^4_\Lambda H$ AND $^4_\Lambda He$. Dabrowski, J. (Inst. for Nuclear Research, Warsaw). Acta Phys. Pol., Ser. B; B6: No. 3, 453-464(1975).

The effect of $A\Sigma$ conversion on the binding energy, B_Λ, of $^4_\Lambda H$ and $^4_\Lambda He$ is calculated in the "hyperon + rigid 3N core" model. For a AN potential derived from $^4_\Lambda He$, one obtains 1.6 MeV for the excitation energy of the J = 1 state, and a very small negative contribution to $B_\Lambda(^4_\Lambda He) - B_\Lambda(^4_\Lambda H)$ due to Coulomb interaction of Σ^+ and Σ^-. (auth)

6529 BETA-DECAY, MAGNETIC MOMENTS, AND THE O(5) GROUP. Krol, S.; Szpikowski, S. (Univ., Marii Curie-Sklodowskiej, Lublin). Acta Phys. Pol., Ser. B; B6: No. 3, 409-419(1975).

Assuming O(5) symmetry (pairing scheme of states for the system of protons and neutrons), the formulas for the probability of Gamov-Teller transition, the magnetic moment, and the probability of the (M1) transition were obtained as well as the relations between them. The comparison with the experimental data shows, except for few cases, quite good agreement in the region of light and very light nuclei. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstract 6572.

6530 CONTRIBUTION FROM THE (K_{min} + 2) HARMONICS TO THE GROUND ENERGY OF ^{16}O. Sadovoi, A. A.; Simonov, Yu. A. Yadern. Fiz.; 22: No. 1, 65-76(Jul 1975). (In Russian)

The contribution from the higher harmonics to the ground energy of ^{16}O is investigated based on the mathematical method developed previously and using the (K_{min} + 2) harmonics. The calculations show that the ground-state energy is sensitive mainly to magnitude of the matrix elements between the lower and higher harmonics, while the effect of mixture of the higher harmonics in the nuclear wave function (in normalization) is more sensitive to the magnitude of the diagonal matrix elements between the higher harmonics. To use the nucleon-nucleon potentials in the calculations the contribution from the (K_{min} + 2) harmonics to the 0^+ energy of ^{16}O nucleus is estimated as 25%, while the admixture of the (K_{min} + 2) harmonics in the wave function of these states is no more than 35%. (auth)

6531 PARTICLE-HOLE-ROTATOR COUPLING MODEL FOR THE GIANT RESONANCE OF ^{12}C. McDougall, A.; Spicer, B. M. (School of Physics, Melbourne). Aust. J. Phys.; 28: No. 1, 127-131(Feb 1975).

A collective correlations calculation has been made for the giant resonance of ^{12}C. The low-lying states are treated as members of two rotational bands, and higher energy low-lying states are included in the coupling procedure in an attempt to examine the connection of these states with structure in the 30 to 35 MeV region, and to examine a proposed rotational band of states built on the 7.65 MeV (0^-) level. The calculation fails to transfer strength to the extent expected. (auth)

6532 FEATURES OF LOW LYING 0^+ STATES OF THE ^{16}O NUCLEUS TAKING INTO ACCOUNT THE MULTIQUANTUM EXCITATIONS. Petrauskas, A. K.; Kamuntavichyus, G. P.; Sabalyauskas, L. Yu.; Yankauskas, K. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Yadern. Fiz.; 22: No. 1, 77-82(Jul 1975). (In Russian)

The total energies, the radii and the matrix elements of the monopole transitions for low lying 0^+ states of the ^{16}O nucleus are calculated taking into account the states with a large number of quanta. (auth)

6533 INVESTIGATION OF THE REACTION (d,^{6}Li) ON NUCLEI ^{19}F AT THE DEUTERON ENERGY OF 13.6 MeV. Goryunov, O. Yu.; Dobrikov, V. N.; Nemets, O. F.; Reuk, E. P.; Rudchik, A. T. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 22: No. 1, 31-35(Jul 1975). (In Russian)

Differential cross sections of the reaction $^{19}F(d, {}^6Li)\ ^{15}N_{ground}$ are measured using the cyclotron beam of deuterons with energy of 13.6 MeV. A manifest diffraction picture is observed in the differential cross sections. The experimental data are analyzed on basis of the theory of α-particle pick-up in the distorted-wave approximation with the zero-range interaction. (auth)

6534 ^{6}Li(d,d'): DIRECT BREAKUP EFFECTS AND PARAMETERS OF THE FIRST 2^+ LEVEL OF ^{6}Li. Bray, K. H.; Frawley, A. D.; Ophel, T. R.; Treacy, P. B. (Australian National Univ., Canberra). Aust. J. Phys.; 28: No. 1, 235-238(Feb 1975).

The reaction ^{6}Li(d, d') has been used to populate the first $J^\pi = 2^+$ level of ^{6}Li. To obtain level parameters, use has been made of a reaction theory which allows for direct breakup effects. The width obtained is 1.82 ± 0.11 MeV, which is consistent with results of ^{4}He + d scattering experiments, though some detailed discrepancies remain unexplained. The position of the level is found to be 4.32 ± 0.04 MeV. (auth)

6535 DWBA ANALYSIS OF POLARIZATION OF PROTONS FROM THE $^9Be(d,p_1)^{10}Be^x$ REACTION AT E_d = 5.5, 15.0, AND 20.5 MeV. Bondouk, I. I. (Inst. of Atomic Physics, Bucharest). Ann. Phys. (Leipzig); 32: No. 2, 119-121(1975).

The polarization of protons from the $^9Be(d,p_1)^{10}Be^x$ reaction was analyzed in terms of the DWBA theory at deuteron energies 5.5, 15.0 and 20.5 MeV. Good fits were obtained which show the usefulness of the DWBA theory for describing polarization by using the optimum optical model parameters. (auth)

6536 DWBA ANALYSIS OF POLARIZATION OF PROTONS FROM THE $^9Be(d,p_0)^{10}Be$ REACTION AT E_d = 6.0, 7.8, AND 10.0 MeV. Bondouk, I. I. (Atomic Energy Establishment, Cairo). Ann. Phys. (Leipzig); 32: No. 3, 202-204(Mar 1975).

The polarization of protons from the $^9Be(d,p_0)^{10}Be$ reaction was analyzed in terms of the DWBA theory at the deuteron energies 6.0, 7.8, and 10.0 MeV. (auth)

6537 LIFETIME OF THE FIRST EXCITED ^{7}Li STATE. Georgieva, M.; Toumbev, G. (Inst. of Nuclear Research, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 5, 609-611(1975).

The lifetimes of excited nuclear states are particularly sensitive to nuclear structure. Doppler-broadening of the 477-keV line emitted by the first excited state of ^{7}Li was studied. From this the lifetime of the level was determined to be $(5.5 \pm 0.1) \times 10^{-14}$s. (2 figures) (RWR)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

6538 ODD-MASS 2s-1d-SHELL NUCLEI IN HARTREE–FOCK–BOGOLIUBOV APPROACH. Sandhu, T. S.; Rustgi, M. L. (State Univ. of New York, Buffalo). Lett. Nuovo Cim.; 14: No. 5, 161-164(4 Oct 1975).

The odd-mass nuclei in the sd-shell are studied within the framework of the Hartree–Fock–Bogoliubov procedure. The single-particle orbitals are assumed to have good magnetic quantum numbers, and the blocking effect due to the presence of the odd nucleon was taken into account. The calculations were performed using the matrix elements of Kuo and Kuo and Brown. Results for neon-21, magnesium-25, sulfur-33, sodium-23, aluminium-27, and chlorine-35 are presented. (JFP)

6539 PROMPT FISSION NEUTRON SPECTRA IN SUPERCRITICAL ACCIDENTS (INFLUENCE ON THE FISSION SPECTRUM-AVERAGED CROSS-SECTIONS OF SOME THRESHOLD ACTIVATION REACTIONS). Ro, S. G.; Jun, J. S. (Korea Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 7: No. 2, 119-126(Jun 1975).

On the assumption that the spectral distribution of prompt fission neutrons released from supercritical accidents can be expressed by the generalized Cranberg form with two spectral parameters, which is then transformed into the single-parameter form, a variation of the fission spectrum-averaged cross sections for some threshold reactions with varying spectral parameter was calculated with an electronic computer. It appears that the average cross sections are very sensitive to the spectral deformation; in particular, those for detectors having threshold at high neutron energy are high compared to those for the detectors of which the threshold energies are comparatively low. (6 figures, 2 tables) (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

6540 ANGULAR CORRELATION MEASUREMENTS IN ^{57}Fe. Taylor, R. B.; Hille, F. (Univ. of North Queensland, Townsville, Australia). Aust. J. Phys.; 28: No. 1, 21-24(Feb 1975).

The results of two gamma-gamma correlation measurements following the thermal capture of neutrons in ^{57}Fe are presented. The spin of the 1.725 MeV state is found to be $\frac{3}{2}^-$ and that of the 1.627 MeV state to be $\frac{3}{2}^-(\frac{5}{2}^-)$. The mixing ratios for the decay of the two states have been calculated. (auth)

6541 INVESTIGATION OF THE $\frac{3}{2}^-$ 770 keV SHORT-LIVED ISOMERIC STATE OF ^{51}Cr EXCITED BY 14.7 MeV FAST NEUTRONS. Deak, F.; Gueth, S.; Kalman, P.; Kiss, A. (Roland Eotvos Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 37: No. 4, 339-342(1974).

The production of the $\frac{3}{2}^-$ 770 keV short-lived isomeric state of ^{51}Cr was investigated in the ^{52}Cr(n, 2n) reaction at 14.7 MeV neutron energy. The measured cross section, combined with that known for the whole (n, 2n) process from other experiments, was used to determine the spin-cut-off factor after deriving the isomeric ratio. The halflife of the $\frac{3}{2}^-$ state was deduced as well. (2 figures, 1 table) (auth)

6542 PROTON SCATTERING ON ^{55}Mn NUCLEUS. Antropov, A. E.; Gusev, V. P.; Zarubin, P. P.; Ioannu, P. D.; Orlov, B. N. (Leningrad State Univ.). Yadern. Fiz.; 22: No. 1, 21-30(Jul 1975). (In Russian)

Angular distributions are measured of protons with energy of 6.02 and 5.90 MeV elastically scattered on the ^{55}Mn nucleus, as well as the inelastic scattering cross sections for the excitation energies up to 2.90 MeV. The excitation function for the ground state of ^{55}Mn is obtained in the energy interval 6 to 5.2 MeV. The measured elastic scattering cross sections are analyzed on basis of the optical model with account of scattering via the compound

nucleus. The obtained experimental results on the angular distributions of inelastically scattered protons were analyzed in framework of DWBA and the Hauser–Feshbach theory. The contribution from scattering via the compound nucleus is estimated for every state of ^{55}Mn. Spins and parities of some highly excited levels of this nucleus are established more precisely. An attempt to apply the excited core model to description of the low lying states of ^{55}Mn nucleus was made. (auth)

6543 SEARCH FOR HEAVY FAST FRAGMENTS OR RECOIL NUCLEI IN THE INTERACTION OF 21-GeV NEUTRONS AND 700-MeV ALPHAS ON Hg, Ta, Ce, Y, Cu, Mn, AND Ca. Reist, H. W.; Hahn, B.; Moser, U. (Univ., Bern). Helv. Phys. Acta; 48: No. 3, vp(1975). (In German)

Heavy and fast nuclear fragments or nuclear recoils in interactions of 21-GeV neutrons and 700-MeV alphas with Hg, Ta, Ce, Y, Cu, Mn, and Ca were searched with a completely new technique, the spinner technique. The measured dE/dx of the fragments corresponds to an energy transfer up to $3 \cdot 10^{-2}$ and $9 \cdot 10^{-2}$ MeV/amu in collisions with the neutrons and alpha particles respectively at the cross section of 10^{-30} cm^2. There was no evidence observed for a compound nucleus formation with the alphas. The demonstrated higher energy transfer by the alphas opens the possibility of looking for hypothetical, heavy elementary particles or quanta by the detection of the local energy deliberated in collisions with nuclei. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstract 6543.

6544 ELASTIC AND INELASTIC SCATTERING OF 27.2-MeV ALPHA PARTICLES BY NICKEL ISOTOPES. Alekseev, V. V.; Nemets, O. F.; Striuk, Yu. S.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 39: 123-130(Jan 1975). (In Russian).

From 24th annual conference on nuclear spectroscopy and the structure of atomic nuclei; Kharkov, USSR (29 Jan 1974).

Measurements were made of the differential elastic and inelastic scattering cross sections for alpha particles scattered by Ni-62 and Ni-64. Earlier data on scattering by Ni-58 and Ni-60 were refined. The measurements were made for scattering angles from 15 to 175 degrees with an angular interval from 1 to 3 degrees. Excitation of the lowest 2/1/(+) and 3/1/(–) collective states was investigated. (IAA)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstract 6539.

6545 (JINR-P3-9099) TOTAL α-WIDTHS OF ^{147}Sm AND ^{149}Sm NEUTRON RESONANCES. Balabanov, N. P.; Gledenov, Yu. M.; Cher, P. Kh.; Popov, Yu. P.; Semenov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The yields in (n, α) reactions on ^{147}Sm and ^{149}Sm were measured. Values were obtained for the total α widths or their upper limits for more than 90 resonances. The average α widths were compared with the predictions of the optical and cluster models. In the case of resonances of ^{149}Sm with 4^- spin, a significantly narrower distribution was obtained for the α widths than would be expected from the statistical model. (tr-auth)

6546 (JINR-P4-9052) SEMIMICROSCOPIC CALCULATION OF THE NEUTRON STRENGTH IN SPHERICAL NUCLEI. Soloviev, V. G.; Stoyanov, Ch.; Dambasuren, D.; Vdovin, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 19p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The fragmentation of single-particle states in spherical odd-A nuclei is investigated in the framework of the model taking into account quasiparticle-phonon interaction. The S- and p- wave neutron strength functions are calculated. The theoretical results for Sn and Te isotopes are in satisfactory agreement with experimental ones. (2 tables, 2 figures) (auth)

6547 (JUL-1218) GAMMA SPECTROSCOPY OF ^{105}Ru. Gueven, H. H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Jul 1975. 73p. (In German). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Koeln Univ.

The γ radiation emitted after the absorption of thermal neutrons in ^{104}Ru was measured in order to complete the previous level and γ decay scheme of ^{105}Ru and to determine the state spins, multipolarities, and mixing ratio of the electromagnetic radiation in the transition between these states. Individual γ spectra, γ-γ coincidences, and γ-γ angular correlations were measured. The previous level scheme of ^{105}Ru was expanded in the low-energy region (E < 1060 keV) to ten new levels. On the 122 γ lines (E ≤ 1 MeV) 98 could be assigned in this level scheme. Spins of the excited states, multipolarities, and mixing ratio of the γ transitions were determined from γ-γ angular correlation measurements on a number of double and triple cascades. Properties of the excited states were discussed individually. On the basis of the data obtained, an attempt was made to interpret a part of the state of ^{105}Ru in the framework of the shell model, the core excitation model, and the rotation model. (tr-auth)

6548 (LBL--4081) CONTINUUM GAMMA RAYS FOLLOWING (HI, xn gamma) REACTIONS. Diamond, R. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1975. Contract W-7405-eng-48. 50p. (CONF-750848--1). Dep. NTIS $5.50.

From 8th summer school on nuclear physics; Mikotajki, Poland (24 Aug 1975).

The continuum gamma-ray spectrum following neutron emission in a (HI, xn gamma) reaction consists of two parts: a high-energy component whose intensity decreases exponentially with gamma-energy, the initial statistical cascade; and a low-energy bump which usually contains most of the intensity and consists predominantly of stretched E2 transitions, the yrast cascade. The latter cascade carries away most of the angular momentum of the product nucleus, and so there is a good correlation between the average angular momentum of the initial compound nucleus leading to a particular product and the average gamma-ray multiplicity in that reaction. The measured values of the gamma-ray multiplicity show a variation of a factor of ten and have dependencies on the projectile mass and energy which can be explained with simple considerations. Determination of the moment-of-inertia of the nucleus at spins as high as 60h/2 pi involves difficulties and is not yet accurate, but is very interesting to do and seems possible of better accuracy. (1 table, 16 figures) (auth)

6549 NEW ISOTOPE ^{148}Dy. Investigation of ^{148,150,152}Dy Decay. Gromov, K. Ya.; Zuber, K.; Zuber, Ya.; Lyatushinski, A.; Penev, I.; Potempa, A. V.; Zelinski, A.; Zhuk, V. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., Ser. B; B6: No. 3, 421-425(1975). (In Polish)

A new isotope of ^{148}Dy was found. The internal conversion electrons and gamma-ray spectra, following the decay of ^{148,150,152}Dy were investigated. The decay schemes of these isotopes were proposed. (auth)

6550 DECAY SCHEMES OF ^{123}Ba AND ^{125}Ba. Arlt, R.; Jasinski, A.; Neubert, W.; Ortlepp, H. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., Ser. B; B6: No. 3, 433-441(1975).

The neutron deficient ^{123}Ba and ^{125}Ba isotopes obtained in the ^{116}Sn(^{12}C, 3n)^{123}Ba and ^{117}Sn(^{12}C,4n)^{125}Ba reactions were studied with Ge(Li) detectors. The most intense γ-rays assigned to ^{125}Ba were confirmed in experiment performed with mass-separated sources obtained by spallation reaction from CeO_2 (separation of barium fraction) and Ta (direct isobars separation of A = 125) targets irradiated with 660-MeV protons. Beta-gamma delayed coincidence was measured using NE 102 and Ge(Li) detectors. On the basis of gamma intensities and energy sums the decay schemes are proposed for ^{123}Ba and ^{125}Ba. (auth)

6551 ENERGY SPECTRA OF THE ^{137}Ba, ^{139}Ce, ^{141}Nd, AND ^{143}Sm NUCLEI CALCULATED WITH THE USE OF THE PARTICLE–SURFACE COUPLING STRENGTH DEPENDING ON THE SINGLE NEUTRON–HOLE STATES. Chlebowska, D. (Inst. for Nuclear Research, Warsaw). Acta Phys. Pol., Ser. B; B6: No. 5, 775-781(1975).

Particle-surface coupling strength matrix elements calculated with Woods-Saxon wave functions are used in the study of the energy spectra of the ^{137}Ba, ^{139}Ce, ^{141}Nd and ^{143}Sm nuclei. The comparison with the theory, in which the coupling strength was treated as a parameter, is made. In both cases the general features of the spectra are similar, although there are some differences, especially in the values of spectroscopic factors. Agreement between calculated nuclear properties and available experimental data is good. (auth)

6552 ISOMER SHIFT AND INFLUENCE OF THE CHEMICAL ENVIRONMENT ON THE LIFETIME OF THE MOESSBAUER

NUCLEUS ^{119}Sn. Roggwiller, P.; Kuendig, W. (Univ., Zurich). Phys. Rev., B; 11: No. 11, 4179-4183(1 Jun 1975).

The influence of the chemical environment on the lifetime of the 23.87-keV state in ^{119}Sn was measured. The result together with Moessbauer measurements gives an experimental determination of the change in the nuclear charge radius during the Moessbauer transition, which is DELTA R/R equals +(1.69 + - 0.22) x 10^{-4}. (auth)

6553 ODD NEUTRON HOLE N = 81 NUCLEI IN THE INTERMEDIATE COUPLING UNIFIED MODEL. Chlebowska, D. (Inst. of Nuclear Research, Warsaw). Acta Phys. Pol., Ser. B; B6: No. 4, 641-650(1975).

The intermediate coupling unified model is applied to the odd neutron hole N = 81 nuclei ^{145}Gd, ^{143}Sm, ^{141}Nd, ^{139}Ce, and ^{137}Ba. In the calculations all the single-neutron hole states of the major shell 50 to 82 are coupled to the N = 82 core excitations up to three phonons. The spectra of the levels with the spins up to $^{19}/_{2}$ are in agreement with the experiment if the first 4^{+} states in the neighboring N = 82 nuclei are approximated by two-phonon states. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 6543 and 6548.

6554 REFINED VALUE FOR THE HALF-LIFE OF ^{177m}Lu. Ward, T. E.; Chu, Y. Y. (Brookhaven National Lab., Upton, NY). Radiochem. Radioanal. Lett.; 22: No. 1, 1-2(30 Jun 1975).

The half-life of ^{177m}Lu has been refined to 160.10 ± 0.18 d. (auth)

6555 PARAMETERS OF NEUTRON RESONANCES OF THE ISOTOPES ^{161}Dy AND ^{163}Dy. Karzhavina, E. N.; Kim Sek Su; Popov, A. B.; Frankov, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 22: No. 1, 3-12(Jul 1975). (In Russian)

The JINR neutron spectrometer with its resolution of 16 nsec/m was used to measure spins of the neutron resonances of ^{161}Dy and ^{163}Dy by the γ-quanta multiplicity method. The spins and neutron widths for 44 resonances of ^{161}Dy and 38 resonances for ^{163}Dy are determined. The following values of the strength functions are obtained: for ^{161}Dy $S_{J=2} = (1.96 \pm 0.65)\cdot 10^{-4}$, $S_{J=3} = (1.33 \pm 0.42)\cdot 10^{-4}$; for ^{163}Dy $S_{J=2} = (2.1 \pm 0.7)\cdot 10^{-4}$, $S_{J=3} = (1.0 \pm 0.35)\cdot 10^{-4}$. (auth)

6556 IDENTIFICATION OF THE ^{160}Yb ISOTOPE $T_{\frac{1}{2}}$ = (4.8 ± 0.2) MIN. Baier, G.; Gonusek, M.; Zibert, Kh. U.; Zuber, Ya.; Lyabushinski, A.; Penev, I.; Polempa, A. V.; Shtrusnyi, Kh.; Yakhim, M. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol., Ser. B; B6: No. 3, 427-431(1975). (In Russian)

The existence of the 4.8 ± 0.2 min ^{160}Yb activity was established. Five gamma-transitions with energies (in keV) and their relative intensities (in parentheses): 132.23 (9.9), 140.35 (16.6), 173.76 (77.4), 215.78 (32.0), and 372.24 (3.5) were found and assigned to the decay of this isotope. (auth)

6557 STATIC QUADRUPOLE INTERACTION OF COULOMB-EXCITED NUCLEI IMPLANTED IN HEXAGONAL SINGLE CRYSTALS. Roesch, L. P. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta; 48: No. 3, 287-328(1975). (In German)

Quadrupole interactions of the 2^{+} states of ^{182,184,186}W, ^{150,152,154}Sm and ^{188,190,192}Os were studied by using time-integrated perturbed angular correlations after Coulomb excitation. The experiments were performed by using 40-MeV ^{16}O to excite and implant the investigated nuclei in Te, Cd, Zn and Gd single crystals of hexagonal structure. Strong electric quadrupole interactions were observed in selected angular correlations taken as a function of crystal orientation. Ratios of quadrupole moments were determined. Electric field gradients acting on the implanted nuclei in the single crystals were evaluated using values for the quadrupole moments derived from E2 transition probabilities. A comparison with the calculated ionic contribution of the lattice shows that great importance has to be attributed to the conduction electrons. In two cases the sign of the quadrupole interaction was also measured using the polarization after a Coulomb excitation. (auth)

6558 STUDY OF THE ANGULAR DISTRIBUTIONS OF TRITONS FROM THE REACTION ^{162}Dy(d,t)^{161}Dy AT 12.1 MeV. Holan, P.; Rozkos, M.; Sterba, F. (Charles Univ., Prague). Czech. J. Phys.; B25: No. 9, 963-978(1975).

The angular distributions of tritons from the reaction ^{162}Dy(d,t)^{161}Dy were measured. The experimental results were analyzed by a distorted waves Born approximation method and the transferred angular momenta were determined for the stronger transitions. The experimental relative intensities of transitions at 90° were compared with those obtained from the Nilsson's model calculations including Coriolis and pairing effects. Eight rotational bands, built on the $^{5}/_{2}$ + [642], $^{5}/_{2}$ − [523], $^{3}/_{2}$ − [521], $^{1}/_{2}$ − [521], $^{11}/_{2}$ − [505], $^{3}/_{2}$ − [532], $^{1}/_{2}$ − [530] and $^{7}/_{2}$ + [404] Nilsson states were established. Some new information about the strongly mixed even parity $^{1}/_{2}$ + [400], $^{1}/_{2}$ + [660], $^{3}/_{2}$ + [402] and $^{3}/_{2}$ + [651] Nilsson states is presented. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 6543 and 6557.

6559 VOLUME CONSERVING PAIRING AND ROTATIONAL BANDS OF ^{156}Dy, ^{166}Er, AND ^{162}Er. Bochnacki, Z. (Inst. of Nuclear Physics, Krakow); Ploszajczak, M.; Balbutsev, E. B. Acta Phys. Pol., Ser. B; B6: No. 5, 769-774(1975).

Volume-conserving pairing was used to determine the Coriolis-antipairing effect on the rotational bands of ^{156}Dy, ^{166}Er, and ^{162}Er. The results follow the experimental moments of inertia up to the region of the critical spin values quite well. In particular they do not show the too rapid rise of the moment of inertia at low spin values which is difficult to avoid in the "standard pairing" calculation. (auth)

6560 ISOMERIC CROSS SECTION FOR THE ^{197}Au(p,n)^{197,197m}Hg REACTION IN THE ENERGY INTERVAL 6.5 TO 9.5 MeV. Kusch, W. (Inst. of Nuclear Research, Swierk, Poland). Acta Phys. Pol., Ser. B; B6: No. 5, 741-748(1975).

Isomeric ratio in the reaction ^{197}Au(p, n)^{197,197m}Hg, in the energy interval 6.5 to 9.5 MeV, was measured using the activation method. The calculations of σ_m/σ_g values, expected by statistical model, were performed as well, with the application of the scheme described by Huizenga and Vandenbosch. The best fit to the experimental data was obtained for the level density parameter $a \simeq 20$, by the fixed spin-cut-off parameter $\sigma = 4$. On the basis of the same experimental data it was possible to determine the excitation function for (p,n) reaction, which, after normalization, was compared with the theoretical one. (auth)

Nuclear Properties and Reactions, A ≥ 220

6561 (CEA-CONF-3114) STRUCTURES IN ^{232}Th(n,f) AND ^{238}U(n,f) CROSS SECTIONS. Blons, J.; Mazur, C.; Paya, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1975. 4p. (CONF-750303-79). Dep. NTIS (US Sales Only) $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The ^{232}Th(n,f) and ^{238}U(n,f) cross sections have been measured relative to that of ^{235}U up to 6 MeV. The best energy resolution was 3 keV at 1.6 MeV. Below the fission threshold of ^{238}U, intermediate structures are observed. In the ^{232}Th(n,f) cross section, the broad vibrational resonances located above 1 MeV are resolved into sharp structures which are interpreted as rotational states. The angular anisotropy of fission fragments has been also measured in the same energy range. Thereby, values of K and J have been determined for each structure. The moment of inertia of ^{233}Th in shape isometric deformation has been deduced. (4 figures, 1 table) (auth)

6562 (DP-MS-75-87) STATUS OF MEASURED NEUTRON CROSS SECTIONS OF TRANSACTINIUM ISOTOPES FOR THERMAL REACTORS. Benjamin, R. W. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 93p. (CONF-751104-3). Dep. NTIS $7.75.

From IAEA advisory group meeting on transactinium isotope nuclear data; Karlsruhe, F.R. Germany (3 Nov 1975).

Experimentally determined neutron cross sections, resonance parameters, and the average number of neutrons per fission for neutron-induced fission of actinide nuclides in the production chains associated with thermal and near-thermal reactors are summarized and compared with user requests for experimental data. The primary fertile and fissile isotopes ^{232}Th, ^{233}U, ^{235}U,

^{238}U, and ^{239}Pu are excluded from this survey. Integral data, i.e., spectrum-averaged thermal cross sections and resonance integrals, are included, but the emphasis is placed on energy-dependent differential cross sections because of their general utility with any specified neutron energy spectrum. Included with the data summaries are an extensive survey of the literature through August 1975, brief descriptions of measurements known to be in progress or firmly planned for the immediate future, and recommendations for needed measurements. (3 figures, 5 tables) (auth)

6563 (JINR-E4-9070) ON THE ANHARMONICITY OF VIBRATIONAL STATES WITH K = 2^+, 0^-, 1^-, AND 2^- IN DOUBLY EVEN DEFORMED NUCLEI 228 ≤ A ≤ 240. Ivanova, S. P.; Komov, A. L.; Kyrchev, G.; Soloviev, V. G.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 22p. Dep. NTIS (US Sales Only) $5.00.

The influence of the quasiparticle-phonon interaction on the energy and the structure of states with K/sup π/ = 2^+, 0^-, 1^-, 2^- for nuclei in the region 228 ≤ A ≤ 240 is studied. It is shown that the first states are mainly one-phonon, and most of the second states have complex structure. If the values of the constants κ/sup (γ)/ of the multipole-multipole interaction with λ = 2, 3 are fixed so as to reproduce the experimental data on the energies of the first K/sup π/ vibrational states, the consideration of the anharmonicity leads to stabilization of κ/sup λ/ inside the zone in A. (auth)

6564 (JINR-E15-9064) SYNTHESIS OF THE NEW NEUTRON-DEFICIENT ISOTOPES $^{250}102$, ^{242}Fm, AND ^{234}Ku. Chepigin, V. I.; Flerov, G. N.; Iljinov, A. S.; Oganessian, Yu. Ts.; Orlova, O. A.; Popeko, G. S.; Shilov, B. V.; Ter-Akopyan, G. M.; Tretyakova, S. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 34p. Dep. NTIS (US Sales Only) $5.00.

The new neutron-deficient isotopes $^{250}102$, ^{242}Fm, and ^{234}Ku have been synthesized by the reactions $^{233}U(^{22}Ne, 5n)$, ^{204}Pb (^{40}Ar, 2n) and $^{206}Pb(^{50}Ti, 2n)$ respectively. It is found that spontaneous fission is the main mode of their decay. The spontaneous fission half-lives of these isotopes have been measured to be equal to 0.25, 0.8, and 0.5 msec, respectively. Some regularities in the spontaneous fission half-lives of transfermium isotopes are discussed. (9 figures, 2 tables) (auth)

6565 SYMMETRIC AND ASYMMETRIC PHOTOFISSION OF ^{226}Ra. Bazhanov, E. B.; Zhagrov, E. A.; Nemilov, Yu. A.; Nikolaev, V. A.; Selitskii, Yu. A.; Tsipenyuk, Yu. M. Yadern. Fiz.; 22: No. 1, 36-43(Jul 1975). (In Russian).

The distributions of the track diameters of the fission fragments in glass detectors produced from the ^{226}Ra photofission are measured for the boundary energies of bremmstrahlung γ quanta E_0 from 11 to 28 MeV. The symmetric and asymmetric fission components are extracted, E_0 dependence of the yields and anisotropy are obtained. For all excitation energies the anisotropies of symmetric and asymmetric fission are equal within the errors. Near the barrier the fission of ^{226}Ra is predominantly asymmetrical like heavier nuclei. (auth)

6566 ANGULAR DISTRIBUTION OF α TRACKS IN THORIUM-STARS. Anghelescu, D.; Anghelescu, L.; Dima, M.; Vogel, A. (Polytechnic Inst., Bucharest). Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucur.; 36: No. 3, 15-18(1974). (In Rumanian).

Isotropy of tracks in thorium stars is discussed. Possible systematic errors are presented. (4 tables) (auth)

6567 SUPERHEAVY ELEMENTS. Tsang, C. F. (Univ. of California, Berkeley). Phys. Teach.; 13: No. 5, 279-283(May 1975).

Problems relating to the synthesis and study of superheavy elements are reviewed on an elementary level. Focus is on the predicted "island of stability" around Z equals 114. (3 figures) (SDF)

Nuclear Theory

Refer also to abstracts 6278, 6437, 6478, 6483, and 6531.

6568 (JINR-D6-8846) XIV SYMPOSIUM ON NUCLEAR SPECTROSCOPY AND NUCLEAR THEORY, DUBNA, JULY 15-19, 1975. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 180p. (In Russian and English). (CONF-750743-(Absts.)).

From 14th symposium on nuclear spectroscopy and nuclear theory; Dubna, USSR (15 Jul 1975).

The collection includes the abstracts for the reports, submitted to the Symposium, which cover the newest results of theoretical and experimental investigations on atomic nucleus structure. The series of reports are devoted to the problems concerned with the technique of obtaining and mathematically processing spectrometric data. (auth)

6569 RAPIDITY SPECTRUM OF THE ENERGY FLUX MODEL. Calucci, G. (Univ., Trieste, Italy). Lett. Nuovo Cim.; 14: No. 5, 153-157(4 Oct 1975).

The energy flux model, which describes the collision of high energy hadrons on nuclei, is taken literally, but it is also taken into account that the successive collisions inside the nucleus take place at variable intervals. This fact gives rise to a smoothing of the sharp transitions between the faster and slower part of the spectrum. Making use also of numerical examples, one tries then to see how relevant this smoothing effect is and how it depends on the initial rapidity and on the atomic weight of the target. (JFP)

6570 DENSITY OF SURFACE NUCLEAR ENERGY IN STATISTICAL MODEL. Il'in, A. P. (Inst. of Nuclear Research, Kiev). Yadern. Fiz.; 22: No. 1, 53-64(Jul 1975). (In Russian)

A method is developed for the representation of surface nuclear energy functional, which is obtained in the framework of statistical method in the form similar to the analogous functional in the droplet nuclear model. (auth)

6571 THERMODYNAMICS OF ELECTROMAGNETIC RADIATION FOR ROTATIONAL STATES OF ATOMIC NUCLEI. Kuzhir, P. G. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 3, 118-120(1975). (In Russian)

Starting from the theory of a Landau Fermi-liquid a number of the thermodynamic characteristics of the excited states of atomic nuclei are obtained. Formulas are obtained by means of which it is readily possible to find the temperature of the nucleus and its entrophy from corresponding experimental data. 5 refs. (SJR)

6572 TWO-STEP EFFECTS IN TRANSFER REACTIONS IN THE DISPERSION THEORY. Luk'yanov, V. K.; Titov, A. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 22: No. 1, 83-90(Jul 1975). (In Russian)

The two-step transfer reactions are considered in the framework of the dispersion theory of direct nuclear reactions. It is assumed that two-step effects are due to the contribution from such triangular diagrams which include a vertex corresponding to the excitation of a nucleus in the in or outgoing channel. For an example, the calculation is made and compared with data for the reaction $^{12}C(d, ^3He)^{11}B$. The dependence of the two-step reaction cross sections upon the kinetic energy of bombarding particles is analyzed. (auth)

6573 POLARIZATION OF MODERATE ENERGY NUCLEONS IN ELASTIC AND INELASTIC DIFFRACTIVE SCATTERING ON ATOMIC NUCLEI. Berezhnoi, Yu. A.; Shlyakhov, N. A. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 22: No. 1, 97-103(Jul 1975). (In Russian)

The formula are obtained for the polarization of moderate energy spin ½ particles in elastic and inelastic scattering by spin-zero nuclei taking into account the Coulomb interaction. The limit expressions studied are consistent with various earlier models for cross sections and polarization. The numerical results agree with the experimental data. (auth)

6574 RESONANCE SCATTERING OF NEUTRONS BY ODD NUCLEI AND THE OPTICAL POTENTIALS. Knyaz'kov, O. M.; Zagrebaev, V. I. Vestn. Leningrad. Univ., Fiz., Khim.; No. 2, 25-29(May 1975). (In Russian)

The resonance scattering of neutrons by odd nuclei is considered, two-particle states being taken as intermediate ones. The energies and the widths of the two-particle resonances were calculated on the basis of the semi-phenomenological model effective two-particle interaction. The resonance structure of the imaginary part of the optical potential was investigated, antisymmetrization effects being taken into account. (auth)

6575 NOTE ON UNITARITY IN RESONANCE THEORY. Bertram, W. K.; Cook, J. L. (Australian Atomic Energy Research Establishment, Sutherland). Aust. J. Phys.; 28: No. 1, 1-5(Feb 1975).

Equations resulting from the unitarity of the collision matrix are investigated in standard resonance theory. The nonuniqueness or otherwise of fitted resonance parameters is discussed. (auth)

6576 ASYMMETRY OF NUCLEAR FISSION WITH ACCOUNT OF THE SHELL EFFECTS. Zimina, O. V. (Moscow Energy Inst.). Yadern. Fiz.; 22: No. 1, 44-52(Jul 1975). (In Russian)

Total energy of the fissible nucleus before the breaking of the scission neck is calculated with account of the fragment shell effects. It is shown that minimum of the energy corresponds to the asymmetrical fission. (auth)

6577 EXACTLY SOLUBLE MODEL OF THE VOLUME CONSERVING PAIRING. Balbutsev, E. B. (Joint Inst. for Nuclear Research, Dubna, USSR); Ploszajczak, M. Acta Phys. Pol., Ser. B; B6: No. 5, 761-768(1975).

An exactly soluble model for the volume conserving pairing is formulated. It is shown that the nonzero equilibrium energy gap exists only in nuclei having irregularities in spectra near the Fermi surface. (auth)

6578 NEUTRON MATTER WITH RECENT NONLOCAL SEPARABLE NUCLEON-NUCLEON POTENTIALS. Haensel, P. (Warsaw Univ.); Meyer, J. Acta Phys. Pol., Ser. B; B6: No. 5, 749-753(1975).

The nonlocal separable nucleon-nucleon potentials, recently applied in the nuclear matter calculations, are used within the frame of the Brueckner theory for the calculation of the equation of state of the pure neutron matter. The results for the potentials, which proved to be most promising in the nuclear matter calculations, coincide with those obtained for the Reid soft core potential in the lowest-order Brueckner theory. (auth)

6579 BRUECKNER-GAMMEL APPROXIMATION FOR THE MAGNETIC SUSCEPTIBILITY OF NEUTRON MATTER. Haensel, P. (Warsaw Univ.). Acta Phys. Pol., Ser. B; B6: No. 5, 749-759(1975).

The magnetic susceptibility of neutron matter is calculated in the lowest order Brueckner theory for the Reid soft core potential. The rearrangement contributions calculated using the approximation of Brueckner and Gammel are important at the highest densities considered. Contrary to the case of liquid ^{3}He, the results obtained using Brueckner and Gammel approximation coincide with those obtained previously within the frame of the Landau theory of Fermi liquids. (auth)

6580 DENSITY FLUCTUATIONS IN NUCLEAR MATTER. Calogero, F. (Univ., Rome); Ragnisco, O.; Palumbo, F. Nuovo Cim., 29A: No. 4, 509-547(21 Oct 1975).

Variational computations of the binding energy per particle for various models of nuclear matter are reported. The main purpose is to compare the results corresponding to a «semicrystallic» structure characterized by correlated density fluctuations of the four spin-isospin nucleon types, with those corresponding to the standard «Fermi gas» homogeneous and isotropic nuclear-matter structure. It is found that, in some cases, the semicrystallic configuration yields more overall attraction (actually less overall repulsion) than the Fermi-gas case, already at (mean) nuclear densities equal to the central density of ordinary (heavy) nuclei. This effect becomes more pronounced at higher (mean) nuclear densities; it can, in most cases, be attributed, at least in part, to the tensor component of the nuclear interaction, that averages to zero in the Fermi-gas case, and yields instead an attractive contribution in configurations with appropriately correlated density fluctuations of the four spin-isospin nucleon states. All computatations are based on realistic one-boson exchange nucleon-nucleon potentials. The correlations associated with the strong repulsive character of the nucleon-nucleon interaction at short range have not been properly accounted for. The results have therefore no immediate phenomenological implications; whether the effect displayed is preserved when the repulsive core of the nucleon-nucleon interaction is properly taken into account (both in the computations with and without density fluctuations) remains an open question. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 6279, 6297, and 6589.

6581 (CONF-751101-29) METHOD FOR PROCESSING ENDF/B PHOTON FORM FACTOR DATA. Lucius, J. L.; Greene, N. M. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Computer Sciences Div.). 1975. 4p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A method is described for processing ENDF/B photon data to generate group-to-group scattering matrices. The method has these salient features: (1) It is tailored toward treating the full energy and angular detail with which the cross sections are represented in ENDF/B; (2) It is simple to program; (3) It closely parallels a treatment developed for producing multigroup neutron matrices; (4) The time required to execute the method on a computer varies linearly with the number of energy groups as opposed to double numerical integration schemes which tend to vary as the square of the number of groups. (GHT)

6582 (JINR-P16-9123) NEUTRON FIELD NEAR THE π-MESON BEAM FOR MEDICAL AND BIOLOGICAL RESEARCH ON SYNCHROCYCLOTRON OF THE LABORATORY OF NUCLEAR PROBLEMS OF THE JOINT INSTITUTE FOR NUCLEAR RESEARCH. Aleinikov, V. E.; Bamblevskii, V. P.; Cherevatenko, E. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The results are presented of measurements of energy spectra and dose equivalent rates of neutrons in the object radiation region by π-meson beam for medical and biological research on synchrocyclotron of the Laboratory of Nuclear Problems JINR. The method of statistical regularization was applied to unfolding the spectra from the readings of the activation indium detectors exposed in polyethylene sphere moderators as well as from those of the carbon containing detector. (auth)

6583 (LA-UR-1490) MICRODOSIMETRY OF NEGATIVE PIONS. Amols, H. I.; Dicello, J. F.; Lane, T. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-Eng-36. 20p. (CONF-750927-1). Dep. NTIS $4.00.

From 5th symposium on microdosimetry; Varbania Pallanza, Italy (22 Sep 1975).

The radiation quality of negative and positive pions of initial momentum 168 MeV/c has been determined at eight different depths in a liquid phantom. The measurements were made with a 2.5 cm diameter spherical proportional counter with Shonka A-150 neutron tissue equivalent plastic walls. The gas pressure in the sensitive volume was chosen to simulate a diameter of 2 mu m in unit density material. Dose distributions as a function of lineal energy (y) change slowly in the entrance and plateau regions with a dose mean lineal energy (anti y/sub D/) of 6-8 keV/mu m. Less than 3 percent of the dose is delivered in excess of 50 keV/mu m in this region. In the Bragg peak region the distributions change rapidly as a function of depth with the dose mean lineal energy increasing to 38 keV/mu m at the peak and to 57 keV/mu m just beyond the peak. On the basis of these microdosimetric data predictions of RBE and OER have been made with the use of both the theory of dual radiation action and also the delta ray theory of cell survival. The former has been used to predict biological response at low doses and the latter at high doses. A comparison is made between the two theories at intermediate doses. The results of these calculations are not inconsistent with recent biological data. (6 figures, 1 table, 20 references) (auth)

6584 (ORNL-TM-5088) EFFECTS OF TISSUE INHOMOGENEITIES ON DOSE PATTERNS IN CYLINDERS IRRADIATED BY NEGATIVE PION BEAMS. Hamm, R. N.; Wright, H. A.; Turner, J. E. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 43p. Dep. NTIS $4.00.

Effects of the presence of inhomogeneities in tissue irradiated by negative pion beams are investigated. Soft-tissue targets are considered with embedded regions of bone and cavities of air. The absorbed dose is calculated as a function of position in the targets for parallel and converging beams and for two parallel beams that enter the target from opposite sides. Isodose contours are calculated and displayed in each case. While these studies show expected trends, they indicate that specific calculations are needed for other beam parameters and target geometries. The contributions of neutrons to the dose contours can be seen from several calculations made both with and without neutrons. (auth)

6585 (SAND-75-0420) RELATIVISTIC E-BEAM ENERGY DEPOSITION IN H_2-F_2 MIXTURES. McGuire, E. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1975. Contract AT(29-1)-789. 66p. Dep. NTIS $5.45.

The production of free fluorine is examined via relativistic electron beam energy deposition in 1:4 mixtures of H_2 and F_2, at atmospheric pressures, on nanosecond timescales. It is found that each free fluorine costs about 9 eV. Key elements in the model are (1) a high H_2 pressure is necessary to slow down fast secondary electrons to the 0-2 eV range on a nanosecond time scale, (2) the initial F atom production mechanism is $e + F_2$ yields F_2^- yields $F + F^-$, while (3) the bulk of the F atom production is via $F^- + F_2^+$ yields 3F. The largest uncertainties in the model are the width of the $e + F_2$ yields F_2^- resonance reaction, and the magnitude of the mutual neutralization cross-section. (18 figures, 26 references) (auth)

6586 CALCULATION OF PHOTOELECTRIC CROSS SECTIONS FOR THE STATISTICAL SIMULATION OF TRANSPORT PROCESSES. Marenkov, O. S. Sov. At. Energy (Engl. Transl.); 33: No. 6, 1153-1154(Dec 1972).

Translated from At. Energ.; 33: No. 6, 987-988(Dec 1972).

A variation of the analytic approximation of the energy dependence of the photoelectric cross section $\tau(\epsilon)$ based on tabulated reference data is presented. Summary tables are presented of total and partial cross sections for 100 elements in the 0.001–100 MeV energy range. The tables show that the energy dependence of the photoelectric cross section $\tau(\epsilon)$ can be approximated by $\tau(\epsilon) = \sum_{i=0}^{4} \tau_i \cdot \epsilon^{-i}$ with an error of no more than 3% over a wide energy range $\epsilon \geq \epsilon_k$. The values of τ_i, calculated by the method of least squares using power type weighting functions, are tabulated for 48 elements most frequently encountered in applied and technical nuclear physics problems. (GHT)

6587 MICRODOSIMETRY OF 14.7 MeV NEUTRONS IN TISSUE EQUIVALENT PHANTOM. Amols, H. I. Providence; Brown Univ. (1974). 109p. University Microfilms Order No. 75-9117.

Thesis (Ph. D.).

An experimental and theoretical investigation has been made of energy deposition in tissue by neutrons. A one-half inch diameter Rossi type proportional counter was used to simulate a one-micron sphere of tissue. Event-size spectra were taken in air, and at various positions in a large volume of tissue equivalent fluid. From the raw spectra, LET distributions were determined, as well as dose fractions for protons, alphas, and heavy ions, and dose average and track-average LET values. The shape of the D(L) vs. LET curve is found to undergo significant change in the phantom due to moderation of the neutron beam. In addition, previous calculations of LET spectra in air are shown to be in error, and theoretical RBE and OER values, based on data from this experiment are in better agreement with biological results. A two-step theoretical calculation has also been carried out. An original Monte Carlo computer code was used to calculate neutron fluences in phantom, which were converted to LET distributions via standard algorithms. Agreement with experiment is very good, both in air and in phantom. Edge effects, backscatter effects, and effects of phantom size were also studied. (Diss. Abstr. Int., B)

Radiation Protection Standards

Refer also to abstract 5644.

Shielding Calculations and Experiments

Refer also to abstracts 6581 and 6866.

6588 (CONF-751041-1) AVAILABLE COMPUTER CODES AND DATA FOR RADIATION TRANSPORT ANALYSIS. Trubey, D. K.; Maskewitz, B. F.; Roussin, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 5p. Dep. NTIS $4.00.

From symposium on vulnerability and survivability of surface and aerial targets; San Diego, California, USA (21 Oct 1975).

The Radiation Shielding Information Center (RSIC) sponsored and supported by the Energy Research and Development Administration (ERDA) and the Defense Nuclear Agency (DNA)

is a technical institute serving the radiation transport and shielding community. It acquires, selects, stores, retrieves, evaluates, analyzes, synthesizes, and disseminates information on shielding and ionizing radiation transport. The major activities include: (1) operating a computer-based information system and answering inquiries on radiation analysis, (2) collecting, checking out, packaging, and distributing large computer codes, and evaluated and processed data libraries. The data packages include multigroup coupled neutron-gamma-ray cross sections and kerma coefficients, other nuclear data, and radiation transport benchmark problem results. (auth)

6589 ELECTROMAGNETIC PROXIMITY EFFECTS AND THEIR CONSEQUENCES FOR RADIATION SHIELDING. Hargreaves, C. M. (Philips Research Labs., Eindhoven, Netherlands). pp 574-577 of Proceedings of the Fifth International Cryogenic Engineering Conference. Mendelssohn, K. (ed.). Guildford, Eng.; IPC Science and Technology Press Ltd. (1974).

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

An outline is given of some ideas and experiments concerning proximity effects in the transfer of radiant energy between closely spaced bodies at different temperatures. Such effects can have important consequences for multiple-foil insulation. For example, when the spacing of two radiation screens is less than about $0.1/T$ cm, where T is their mean absolute temperature, an additional screen midway between them increases the radiation current by a factor of up to $8\times$ instead of reducing it by a factor of about $\frac{1}{2}$. (auth)

PHYSICS (THEORETICAL)

General

6590 (CNRS-CPT-75-P-645) STABILITY AND EQUILIBRIUM IN QUANTUM STATISTICAL MECHANICS. Kastler, D. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). Jan 1975. 16p. (CONF-740759-1). Dep NTIS (US Sales Only) $4.50.

From colloquium on non-commutative harmonic analysis; Marseille, France (1 Jul 1974).

A derivation is provided for the Gibbs ansatz, base of the equilibrium statistical mechanics, from a stability requirement. Also a relation is established between stability and the positivity of the Hamiltonian in the zero temperature case. (JFP)

6591 "FREE-SPACE" BOUNDARY CONDITIONS FOR THE TIME DEPENDENT WAVE EQUATION. Lindman, E. L. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 18: No. 1, 66-78(May 1975).

Boundary conditions for the discrete wave equation which act like an infinite region of free space in contact with the computational region can be constructed using projection operators. Propagating and evanescent waves coming from within the computational region generate no reflected waves as they cross the boundary. At the same time arbitrary waves may be launched into the computational region. Well known projection operators for one-dimensional waves may be used for this purpose in one dimension. Extensions of these operators to higher dimensions along with numerically efficient approximations to them are described for higher-dimensional problems. The separation of waves into ingoing and outgoing waves inherent in these boundary conditions greatly facilitates diagnostics. (auth)

6592 "FREE-SPACE" BOUNDARY CONDITIONS FOR THE TIME-DEPENDENT WAVE EQUATION. Lindman, E. L. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 18: No. 1, 66-78(May 1975).

Boundary conditions for the discrete wave equation which act like an infinite region of free space in contact with the computational region can be constructed using projection operators. Propagating and evanescent waves coming from within the computational region generate no reflected waves as they cross the boundary. At the same time arbitrary waves may be launched into the computational region. Well known projection operators for one-dimensional waves may be used for this purpose in one dimension. Extensions of these operators to higher dimensions along with numerically efficient approximations to them are described for higher-dimensional problems. The separation of waves into ingoing and outgoing waves inherent in these boundary conditions greatly facilitates diagnostics. (auth)

6593 METHOD FOR THE DETERMINATION OF CLEBSCH-GORDAN COEFFICIENTS FOR POINT GROUPS. Lulek, T. (Univ. Adama Mickiewicz, Poznan, Poland). Acta Phys. Pol.; A48: No. 4, 501-512(Oct 1975).

A method for the determination of Clebsch-Gordan coefficients (CGC) for any point group in terms of 3j Wigner symbols for spherical symmetry and of appropriate decomposition coefficients is proposed. The method can also serve for deriving WCG in terms of certain 3jΓ symbols exhibiting high permutational symmetry. (auth)

6594 LOCAL FORM OF THE SOLUTION OF THE CHEW-LOW EQUATIONS. Gerdt, V. P.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 24: No. 2, 155-163(Aug 1975). (In Russian)

The Chew-Low equations in the neighborhood of the degenerated static point are considered. By means of the commutative one parametric abelian group of continuous transformations the solution entering this point is constructed. The solution is represented by the convergent series, depending on three arbitrary functions. (auth)

6595 INVARIANTS, GREEN FUNCTION, AND COHERENT STATES OF DYNAMICAL SYSTEMS. Dodonov, V. V.; Malkin, I. A.; Man'ko, V. I. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 24: No. 2, 164-176(Aug 1975). (In Russian)

The relation between the Green function of a dynamical system and the integrals of the motion which are the operators of initial coordinates and momenta of the system is obtained. The Green function of a system with rather arbitrary hamiltonian, both hermitian and nonhermitian, is shown to be the eigenfunction of the invariant operator of initial coordinate. The quantum system with general quadratic hamiltonian and the singular nonstationary oscillator are discussed as examples. (auth)

6596 NONEQUIVALENT HAMILTONIANS AND RELATIVISTIC SYMMETRY OF MECHANICS. Chylinski, Z. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol., Ser. B; B6: No. 3, 387-395(1975).

The analysis of relativistic free-particle systems inclines one to define a set of nonequivalent Hamiltonians which imply the factorization of all degrees of freedom into groups corresponding to different "clustering" of the constituents of these systems. Within the quantum description all these Hamiltonians lead to self-consistent solutions, although only one of them — call it H_1 — respects the full relativistic symmetry of the laws of motion. In the classical framework the only consistent description of motion follows from H_1, and thus the relativistic covariance is unavoidable. (auth)

6597 COMBINATORIAL ANALYSIS OF THE OVERLAPPING PROBLEM FOR THE DIAGRAMS WITH MORE THAN FOUR EXTERNAL LINES. II. High Legendre Transformations. Pis'mak, Yu. M. (Leningrad State Univ.). Teor. Mat. Fiz.; 24: No. 2, 177-194(Aug 1975). (In Russian)

The properties of the graphs of the m-th Legendre transformation $\Gamma^{(m)}(\epsilon_1, \ldots, \epsilon_m; A_{m+1}, \ldots, A_n)$ of the connected Green function generating functional ($\epsilon_1, \ldots, \epsilon_m$ being dressed variables $A_{m+1}, \ldots, A_n$ being bare ones) are considered. This gives an opportunity to find the explicit expression for the sum of all skeleton graphs included in the representation of the dressed k-leg vertex, $k \leq m$, and containing nontrivial l-leg subgraphs, $l \leq k$. (auth)

6598 MAJORATION ESTIMATES IN THE APPROXIMATING (TRIAL) HAMILTONIANS METHOD. Bogolyubov, N. N. Jr.; Plechko, V. N.; Repnikov, N. F. (Mathematical Inst., Moscow). Teor. Mat. Fiz.; 24: No. 3, 357-367(Sep 1975). (In Russian)

Some new inequalities for averages in the equilibrium statistical mechanics are found which are applied then for improving the majoration estimates in the approximating (trial) Hamiltonians method. The results are illustrated by concrete models. (auth)

6599 FUNCTIONAL INTEGRAL FOR THE CASE OF NONADDITIVE ACTION. Chetverikov, V. M. (Moscow Inst. of Electronic Machinery). Teor. Mat. Fiz.; 24: No. 2, 211-218 (Aug 1975). (In Russian)

The path integral for the case of nonadditive action appeared in the same problems of solid state physics and problems concerning the propagation of the radiation in the random media is considered. The difficulties in comparison with the case of additive action are discussed. For the treated Green function the Dyson type integral equation in which vertex function is represented as the series of perturbation theory is derived. In the one special case the exact solution is received and the non-unitarity of this solution is discussed. (auth)

6600 NONSTATIONARY PERTURBATION THEORY FOR THE ENERGY SHIFTS OF A DEGENERATE LEVEL. Vasil'ev, A. N.; Kitanin, A. L. (Leningrad State Univ.). Teor. Mat. Fiz.; 24: No. 2, 219-229(Aug 1975). (In Russian)

The asymptotic (when $T = t_1 - t_2 \to \infty$) representation for the operator $PS(t_1,t_2)P$ where P is the projector on some degenerate subspace of the nonperturbed energy level and $S(t_1,t_2)$ is the operator of the time development in the interaction picture is obtained. The asymptotic formula is the following: $PS(t_1,t_2)P = R_0 \exp(-i\bar{Q}T) = (\exp\{-i(Q + T)\}) R_0 = R_0^{\infty} \exp(-i\bar{Q}T) R_0^{\infty}$ where Q is the nonhermitian secular operator, R_0 and $\bar{Q}$ are the hermitian operators. (auth)

6601 RAPIDLY CONVERGENT PERTURBATION THEORY FOR THE DISCRETE SPECTRUM. Polikanov, V. S. (Leningrad Inst. of Nuclear Physics). Teor. Mat. Fiz.; 24: No. 2, 230-235(Aug 1975). (In Russian)

The perturbation theory for the discrete spectrum of the radial Schrödinger equation is generalized to the case when nonperturbated function has knots. To the k-th order the eigenfunction is calculated to the accuracy ϵ^{2k}, where ϵ is the perturbation parameter. It is possible to obtain from this eigenfunction the energy to the accuracy ϵ^{2k+1}. All corrections are the quadratures of this function. The dependence on all other parts of spectrum is absent. The expressions for shiftings of the knots under the perturbation are obtained. (auth)

6602 TWO-SIDE ESTIMATES FOR EIGENVALUES OF THE SCHROEDINGER EQUATION. Ryazanov, G. V. (Inst. of Theoretical Physics, Moscow). Teor. Mat. Fiz.; 24: No. 3, 412-418(Sep 1975). (In Russian).

Schroedinger equation is substituted into two systems of n

linear equations with n unknown quantities. The coefficients of these equations are the matrix elements of the hamiltonian between quasiclassical wave functions. The solution of these systems gives the two-side estimates for eigenvalues of the Schroedinger equation. The relative distance between boundary $\sim\lambda^k$, where λ is the parameter of the quasiclassical decomposition for the n-th wave function, k is the number of terms in this decomposition. (auth)

6603 GRAVITATIONAL ENERGY-MOMENTUM ON NONMAXIMAL SURFACES. Deser, S. Brandeis Univ., Waltham, MA). Phys. Rev. Lett.; 12: No. 4, 943-945(15 Aug 1975).

Gravitational Cauchy data defined iteratively from an input set which is of pure linearized gauge form representing a nonflat hypersurface appear to possess tachyonic energy-momentum P/sup mu/. It is shown that such systems do behave correctly: P/sup mu/ is positive timelike, and vanishing of the energy implies flat space. Although the P/sup mu/ begin at quartic order in the inputs, it is possible to exhibit explicitly the helicity-2 character of the gravitational excitations on which both the energy and the flatness conditions depend. (auth)

6604 PATH INTEGRAL REPRESENTATION OF THE REACTION RATE CONSTANT IN QUANTUM MECHANICAL TRANSITION STATE THEORY. Miller, W. H. (Univ. of California, Berkeley). J. Chem. Phys.; 63: No. 3, 1166-1172(1 Aug 1975).

Feynman's path integral representation of the Boltzmann operator e$^-$/sup beta H/ is used to express the rate constant of a recently formulated quantum mechanical version of transition state theory. By evaluating the path integral in two separate stages, one is able to interpret the result as a generalization of a model suggested several years ago by Johnston and Rapp for handling the nonseparable aspect of tunneling in transition state theory. A Fourier series expansion of the path integral is also developed, and this approach has promise for direct numerical evaluation of the quantum rate expression. (auth)

6605 QUANTIZATION OF FIELDS IN ACCORDANCE WITH MODULAR STATISTICS. Green, H. S. (Univ. of Adelaide). Aust. J. Phys.; 28: 115-125(1975).

A new generalization of quantum statistics is described, which is different from parastatistics, though it includes Fermi statistics and parafermi statistics of order two. It can be applied to the quantization of nonlinear field theories, without violating the correspondence principle. Like parastatistics, it allows the occupation of a given dynamical state by more than one particle of half-odd-integral spin. A special feature is that quark-like particles are naturally associated in modules, which have many of the characteristics of baryons and mesons. The group theoretical properties of the new statistics, and the implied classification of states, are briefly examined. (auth)

6606 INTERPOLATION FORMULAS FOR FERMI–DIRAC FUNCTIONS. Kalutin, N. N.; Kuz'mina, L. V. Zh. Vychisl. Mat. i Mat. Fiz.; 15: No. 3, 768-771(1975). (In Russian).

Interpolation formulas expressing some Fermi–Dirac functions through one another were constructed. In all fields of change of the argument, the formulas were precise to 10^{-6}–10^{-8}. (tr-auth)

6607 STOCHASTIC THEORY FOR CLASSICAL AND QUANTUM MECHANICAL SYSTEMS. de la Pena, L.; Cetto, A. M. (Inst. de Fisica, Mexico City). Found. Phys.; 5: No. 2, 355-370 (Jun 1975).

From first principles a theory of stochastic processes in configuration space is formulated. The fundamental equations of the theory are an equation of motion which generalizes Newton's second law and an equation which expresses the condition of conservation of matter. Two types of stochastic motion are possible, both described by the same general equations, but leading in one case to classical Brownian motion behavior and in the other to quantum mechanical behavior. The Schroedinger equation, which is derived with no further assumption, is thus shown to describe a specific stochastic process. It is explicitly shown that only in the quantum mechanical process does the superposition of probability amplitudes give rise to interference phenomena; moreover, the presence of dissipative forces in the Brownian motion equations invalidates the superposition principle. At no point are any special assumptions made concerning the physical nature of the underlying stochastic medium, although some suggestions are discussed in the last section. (auth)

6608 SYMMETRY-BREAKING VACUUM AND STATE VECTOR REDUCTION. Zeh, H. D. (Univ., Heidelberg). Found. Phys.; 5: No. 2, 371-373(Jun 1975).

It is argued by means of analogy with certain irreversible processes that a symmetry-violating vacuum need not necessarily be explained by a special cosmic initial condition. (auth)

6609 RECONSTRUCTION THEOREMS IN QUANTUM MECHANICS. Zabey, P. C. (Univ. of Geneva). Found. Phys.; 5: No. 2, 323-342(Jun 1975).

Given a physical system, one knows that there is a logical duality between its properties and its states. Its states are chosen as the undefined notions of the axiomatic construction. In fact, by means of well motivated assumptions expressed in terms of a transition probability function defined on the set of all pure states of the system, one constructs a system of elementary propositions, i.e., a complete orthomodular atomic lattice satisfying the covering law. One also studies in this framework the important notion of compatibility of propositions, and one defines the superpositions and the mixtures of the states of the physical system. (auth)

6610 BOHR CORRESPONDENCE PRINCIPLE FOR LARGE QUANTUM NUMBERS. Liboff, R. L. (Cornell Univ., Ithaca, NY). Found. Phys.; 5: No. 2, 271-293(Jun 1975).

Periodic systems are considered whose increments in quantum energy grow with quantum number. In the limit of large quantum number, systems are found to give correspondence in form between classical and quantum frequency–energy dependences. Solely passing to large quantum numbers, however, does not guarantee the classical spectrum. For the examples cited, successive quantum frequencies remain separated by the increment hI^{-1}, where I is independent of quantum number. Frequency correspondence follows in Planck's limit, h yields 0. The first example is that of a particle in a cubical box with impenetrable walls. The quantum emission spectrum is found to be uniformly discrete over the whole frequency range. This quality holds in the limit n yields infinity. The discrete spectrum due to transitions in the high quantum-number bound states of a particle in a box with penetrable walls is shown to grow uniformly discrete in the limit that the well becomes infinitely deep. For the infinitely deep spherical well, on the other hand, correspondence is found to be obeyed both in emission and configuration. In all cases studied the classical ensemble gives a continuum of frequencies. (auth)

6611 PROCEDURES FOR THE MEASUREMENT OF QUESTIONS IN QUANTUM MECHANICS. Benioff, P. (Argonne National Lab., IL). Found. Phys.; 5: No. 2, 251-255(Jun 1975).

It is shown that there exist observables A and Borel sets E such that the procedure "measure A and give as output the number I (0) if the A measurement outcome is (is not) in E" does not correspond to a measurement of the proposition observable E/sup A/(E) usually assigned to such procedures. This result is discussed in terms of limitations on choice powers of observers. (auth)

Quantum Field Theories

Refer also to abstract 6426.

6612 (DESY-75/22) CLASSICAL ASPECTS AND FLUCTUATION-BEHAVIOUR OF TWO DIMENSIONAL MODELS IN STATISTICAL MECHANICS AND MANY BODY PHYSICS. Schroer, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Jul 1975. 34p. (CONF-750695-1). Dep. NTIS (US Sales Only) $4.75.

From conference on extended systems in field theory; Paris, France (26 Jun 1975).

The quasiclassical aspects of the D = 2 Lenz-Ising model are sketched. Stationary, position-dependent mean field solutions for the D = 2 Lenz-Ising model, investigation of the critical region, construction of the scale-invariant limit, and the Klein-Gordon equation and superrenormalizable perturbations on Thirring-like models are treated. (JFP)

6613 (DESY-75/24) RENORMALIZATION PROBLEM IN A CLASS OF NONRENORMALIZABLE THEORIES. Symanzik, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1975. 34p. (CONF-750693-1). Dep. NTIS (US Sales Only) $4.75.

From 6th GIFT seminar in theoretical physics; Jaca, Huesca, Spain (2 Jun 1975).

A possible way to approach a certain class of nonrenormalizable theories is described. The simplest theory of this class with a probability of existence is chosen, the massless phi^4 theory in more than four space–time dimensions. The problem of extension to other nonrenormalizable theories in the class considered, and the conclusions reached thus far are compared with the corresponding ones for renormalizable theories. (JFP)

6614 (DESY-75/33) ANOMALIES OF CURRENTS IN THE QUANTIZED KLEIN–GORDON EQUATION. Flume, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1975. 8p. Dep. NTIS (US Sales Only) $4.00.

An investigation is made of the meaning of the (infinitely many)

conserved nontrivial currents of the classical Klein-Gordon equation for conventional quantum perturbation theory of a scalar field ϕ with self-interaction $\{\cos(B\phi)^{-1} + [(B\phi)^2/2]\}$. Radiative corrections produce for all currents anomalies with contributions on the mass shell. (auth)

6615 TACHYON MATTER AND COMPLEX PHYSICAL VARIABLES. Corben, H. C. (Univ. of Toronto). Nuovo Cim.; 29A: No. 3, 415-426(1 Oct 1975).

Some misconceptions concerning tachyons are corrected and it is shown that under superluminal Lorentz transformations some physical quantities that are real in one frame of reference appear in the other to be imaginary. Transfer of electromagnetic radiation between two worlds, each of which judged the other to be composed of tachyon matter, would then cause some of the physical quantities of each world to become complex quantities. (auth)

6616 CHARGED DUST CYLINDER IN GENERAL RELATIVITY. Banerjee, A. (CNRS, Paris); De, U. K. Acta Phys. Acad. Sci. Hung.; 37: No. 4, 363-365(1974).

A class of solutions of the field equations in empty space corresponding to some axially symmetric electrostatic field was first obtained by WEYL. Most of the exact solutions found later for such fields are special cases of WEYL's solutions. The metric is considered in the pseudo-cylindrical form used by MUKHERJEE and solutions of Einstein–Maxwell equations in the matter free space containing only the radial electrostatic field are obtained. The solutions given here are, however, not included in the solutions given by MUKHERJEE and the metric may be interpreted from the boundary conditions as due to a uniformly charged static cylinder of infinite length where the charge-density equals the matter density. (auth)

6617 GENERATING S-MATRIX FUNCTIONAL IN THEORY OF GAUGE FIELDS. I. Vasil'ev, A. N.; Pis'mak, Yu. M. Vestn. Leningrad. Univ., Fiz., Khim.; No. 2, 7-13(May 1975). (In Russian)

The generating S matrix functional for the massless Yang–Mills field is considered in the gauges $nB + C = 0$. The complexity of the connection of the S matrix with Green's functions is discussed. (auth)

6618 NEW PRODUCTS OF THE DISTRIBUTION IN THE QUANTUM FIELD THEORY. Viner, I. Ya. (Vitebsk Technological Inst., USSR). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 130-132(1975). (In Russian)

Multiplication formula of the derivatives of any order of the Dirac delta function was established. (JSR)

6619 TWO NEW LIMITATIONS ON THE ELECTROMAGNETIC FORM FACTORS OF HADRONS. Lomsadze, Yu. M.; Kelemen, V. I.; Krikheli, M. G. (Inst. of Theoretical Physics, Moscow). Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 69-73(1975). (In Russian)

On the basis of very general assumptions, rigidly proven in the traditional axiomatic approach to quantum field theory, and experimental verification of the assumptions on the limitedness of hadron electromagnetic form factors, two new axiomatic limitations were established. (tr-auth)

6620 QUANTIZATION OF THE $(\text{SIN}\ \varphi)_2$-INTERACTION IN TERMS OF FERMION VALUES. Pogrebkov, A. K.; Sushko, V. N. (Mathematical Inst., Moscow). Teor. Mat. Fiz.; 24: No. 3, 425-429(Sep 1075). (In Russian)

Quantization of the $(\sin\varphi)_2$-interaction is performed. It is shown that for the accepted quantization procedure, the Hamiltonian of the $(\sin\varphi)_2$-interaction is equivalent to the Hamiltonian of a fermion field which reduces at definite conditions to the Hamiltonian of the massive Thirring model. (auth)

6621 THEORY OF THE YANG–MILLS FIELDS. Popov, D. A. Teor. Mat. Fiz.; 24: No. 3, 347-356(Sep 1975). (In Russian)

An explicit geometrical description of gauge transformations and Yang–Mills fields in terms of connections in principal and associated vector fibre bundles is given. Using invariant operators on a principal bundle, the equation for the connection is formulated which after the projection on the base space leads to usual equations of the Yang–Mills field corresponding to the quadratic Lagrangian. (auth)

6622 UNITARITY IN A FIELD MODEL WITH UNSTABLE PARTICLES AND WARD IDENTITIES. Blasi, A.; Collina, R. (Univ., Genoa). Lett. Nuovo Cim.; 14: No. 4, 143-146(27 Sep 1975).

The compatibility of unitarity of the S matrix and Ward identities in a renormalizable model with one unstable particle is investigated. The model is the well known σ model with one scalar field σ and a pseudoscalar field π; the associated particles are indicated with the same label and have physical masses m_σ and m_π, respectively. The instability condition for σ is $m_\sigma^2 \geq 4m_\pi^2$. (JFP)

6623 NEUTRAL CURRENTS AND HIGH ENERGY LEPTON–NUCLEON ELASTIC SCATTERING. Fleury, N.; Lopes, J. L. (Univ. Louis Pasteur, Strasbourg). Lett. Nuovo Cim.; 14: No. 4, 147-150(27 Sep 1975).

The cross section for lepton–nucleon elastic scattering is computed in order to exhibit the terms for neutral-current couplings. (JFP)

6624 CLASSICAL SU(3) GAUGE THEORY AND MAGNETIC MONOPOLES. Marciano, W. J.; Pagels, H. (Rockfeller Univ., New York). Phys. Rev. Lett.; 12: No. 4, 1093-1095(15 Aug 1975).

A topologically stable solution to the pure Yang-Mills SU(3) gauge field equations (without scalar fields is constructed) which corresponds to a point magnetic monopole. There is no SU(2) analog to this solution. (auth)

6625 PARTIAL DIAGONALIZATION OF BETHE–SALPETER TYPE EQUATIONS. Cronstroem, C. (Univ. of Helsinki). Ann. Phys. (N.Y.); 92: No. 2, 262-314(Aug 1975).

One considers an equation of the Bethe–Salpeter type, with arbitrary potential and kernel, respectively, for space-like momentum transfer. The invariance group of the equation is then the Lorentz-group in three dimensions, the O(1,2) group. The standard procedure for the diagonalization of such equations (valid for square integrable solutions only) is generalized to include the case of power bounded solutions, by means of a generalized O(1,2) expansion formalism. The result is a two-dimensional integral equation for the O(1,2) expansion coefficients. The right-most l-plane singularities of these determine the asymptotic behavior of the amplitudes as in ordinary Regge theory. The formalism can be applied to other dynamical equations possessing O(1,2) symmetry. (auth)

6626 POSITIVITY PRESERVATION FOR FREE QUANTUM FIELDS. Perez, J. F.; Wilde, I. F. (Univ., Sao Paulo, Brazil). J. Math. Anal. Appl.; 51: No. 1, 94-99(Jul 1975).

Let A be a real Bose or Fermi one-particle operator with parallel A parallel less than I. By use of Kaplansky's density theorem, a simple proof is given of the fact that GAMMA(A), the operator in Fock space induced by A, is positivity preserving in the relevant L^2-space. (auth)

6627 PROGRESS IN QUANTUM FIELD THEORY. Hepp, K. (Eidgenoessische Technische Hochschule, Zurich). pp 23-51 of Highlights in Particle Physics. Vol. 10. Zichichi, A. (ed.). Bologna; Editrice Compositori(1973).

From international school of subnuclear physics; Sicily, Italy (7 Jul 1972). See CONF-720750-.

The discussion of progress in quantum field theory includes the Heisenberg spin chain as a quantum field theory and progress in the understanding of the divergences of quantum field theory. (JFP)

6628 NONPLANAR SOLUTIONS OF THE TWO-BODY PROBLEM IN CLASSICAL ELECTRODYNAMICS. Chern, D. C. (National Central Univ., Chung-Li, Taiwan). Chin. J. Phys. (Taiwan); 12: No. 2, 87-97(Oct 1964).

A class of relativistic nonplanar two-body solutions is found recently by Chern and Havas, which does not have nonrelativistic counterparts. The special case in which the particles interacting through time-symmetric electromagnetic interactions is studied in detail. Ranges and limits of the relevant parameters are calculated numerically. Expressions are obtained for total energy, angular momentum and center of mass. The particular characteristics of the solutions are discussed. (auth)

6629 TACHYONS AND SUPERLUMINAL WAVE GROUPS. Duffey, G. H. (South Dakota State Univ., Brookings). Found. Phys.; 5: No. 2, 349-354(Jun 1975).

In the approximation that every inertial observer experiences a homogeneous, uniform flow of time and sees a space that is Euclidean, the arena of physics is Minkowskian and one speed is the same in all inertial frames. If a given inertial observer finds an infinitesimal source or particle traveling faster than this fundamental speed near a given event, the source must appear in some inertial frame spread over neighboring positions at a given time as a spacelike structure. If this structure persists over a period of proper time, it can be interpreted as a wave group. If it is conserved, it can be interpreted as a line or tube of force. (auth)

6630 CONSISTENCY OF THE POSTULATES OF SPECIAL RELATIVITY. Kingsley, J. M. Found. Phys.; 5: No. 2, 295-300 (Jun 1975).

The special theory of relativity is based on two postulates: (I)

All inertial frames are equivalent for the performance of physical experiments; and (II) the velocity of light is a universal constant. It is shown that if postulate I is true, then postulate II is not true, and if postulate II is true, then postulate I is not true. Further, it is shown that the only possible velocity consistent with postulate I follows the rule that the velocity of light with respect to the observer is equal to the velocity of light with respect to the source plus the velocity of the source with respect to the observer. (auth)

6631 SUPERPOSITION IN QUANTUM AND RELATIVITY PHYSICS: AN INTERACTION INTERPRETATION OF SPECIAL RELATIVITY THEORY. III. Schlegel, R. (Michigan State Univ., East Lansing). Found. Phys.; 5: No. 2, 197-215(Jun 1975).

With the interaction interpretation, the Lorentz transformation of a system arises with selection from a superposition of its states in an observation-interaction. Integration of momentum states of a mass over all possible velocities gives the rest-mass energy. Static electrical and magnetic fields are not found to form such a superposition and are to be taken as irreducible elements. The external superposition consists of those states that are reached only by change of state of motion, whereas the internal superposition contains all the states available to an observer in a single inertial coordinate system. The conjecture is advanced that states of superposition may only be those related by space-time transformations (Lorentz transformations plus space inversion and charge conjugation). The continuum of external and internal superpositions is examined for various masses, and an argument for the unity of the superpositions is presented. (auth)

6632 EMPIRICAL TEST OF THE INTERACTION INTERPRETATION OF THE THEORY OF RELATIVITY. Cannon, W. H.; Jensen, O. G. (York Univ., Toronto). Found. Phys.; 5: No. 2, 217-227(Jun 1975).

An empirical test of Schlegel's "interaction interpretation" of the theory of special relativity is presented. Analysis of the UTC time scales maintained at various observatory sites over the world indicates that neither Schlegel's "interaction interpretation" of the theory of relativity nor the conventional "space-time coordinate transformation interpretation" of relativity can significantly improve agreement between the UTC time scales. Instead evidence for the effects of accelerations on clock rates is suggested. (auth)

6633 CAUSAL INDEPENDENCE IN ALGEBRAIC QUANTUM FIELD THEORY. DeFacio, B. (Ames Lab., IA). Found. Phys.; 5: No. 2, 229-237(Jun 1975).

Ekstein has shown that causal independence neither implies nor is implied by commutativity in an infinite-dimensional, reducible construction. DeFacio and Taylor have presented a finite-dimensional irreducible example of Ekstein's proposition. Avishai and Ekstein have shown that the original question regarding locality for algebraic quantum field theories remains open. One concurs with that claim and offers additional arguments. A new denumerably infinite-dimensional, irreducible example is presented which shows that a sort of "orthogonality" among operators is involved. Some observations on local C*- and W*-algebras are given. (auth)

6634 EXTENDED RELATIVITY: MASS AND THE FIFTH DIMENSION. Edmonds, J. D. Jr. (San Diego State Univ., CA). Found. Phys.; 5: No. 2, 239-249(Jun 1975).

A self-consistent relativistic formalism is presented which postulates that mass is the eigenvalue of a fifth momentum operator component. Lorentz covariance is generalized so that a systematic program for covariant wave equations can be formed. The fifth dimension is identified with cosmic time, resulting in a bias toward matter over antimatter for the universe. A distinction between mu and e also seems possible through the space-time extension. (auth)

6635 NULL CANONICAL FORMALISM. I. Maxwell Field. Wodkiewicz, K. (Univ., Warsaw). Acta Phys. Pol., Ser. B; B6: No. 4, 509-519(1975)

The canonical formalism on null hypersurfaces is formulated for the Maxwell electrodynamics. The set of the Poisson brackets relations for null variables for the Maxwell field is obtained. The asymptotic properties of the theory are investigated. The Poisson bracket relations for the news-functions of the Maxwell field are computed. The Hamiltonian form of the asymptotic Maxwell equations in terms of these news-functions is obtained. (auth)

6636 SPHERICAL SYMMETRY IN RAINICH'S THEORY. Klotz, A. H. (Univ. of Sydney). Acta Phys. Pol., Ser. B; B6: No. 4, 479-488(1975).

A time-dependent, spherically symmetric solution of Rainich's field equations is derived when the field is null. It is concluded that in this case the already unified field theory and the Einstein-Maxwell theory are not equivalent. (auth)

6637 QUANTIZATION OF THE ELECTROMAGNETIC FIELD IN RIEMANNIAN SPACES. Kramer, D. (Friedrich-Schiller Univ., Jena, Ger.). Acta. Phys. Pol., Ser. B; B6: No. 4, 467-478(1975).

The canonical quantization procedure for the free electromagnetic field is generalized on arbitrary space-times. The metric is considered as classical background field which influences the quantized Maxwell field. Using the Heisenberg picture one gets a system of first-order linear ordinary differential equations describing the time dependence of the operators. In order to compute the coefficients of this system one has to solve a 3-dimensional eigenvalue problem. It is not necessary to choose a special gauge of the potentials. (auth)

6638 EXCLUSIVELY GAUGE-INVARIANT QUANTUM ELECTRODYNAMICS: A THEORY WITH A FINITE ELECTRON SOLUTION. Rosen, G. (Drexel Univ., Philadelphia). Lett. Nuovo Cim.; 13: No. 14, 553-554(2 Aug 1975).

Gauge invariant two-point field equations are introduced which yield a finite electron solution. All experimental observables may be calculated in terms of these fields. (SDF)

6639 CLASS OF FADDEEV-POPOV LAGRANGIANS IN GAUGE THEORIES. Frenkel, J. (Univ., Sao Paulo, Brazil). Lett. Nuovo Cim.; 13: No. 14, 529-533(2 Aug 1975).

A non-Abelian Yang-Mills type gauge theory consisting of a set of N gauge fields, one for each group generator, is discussed. It is concluded that, in non-Abelian gauge theories, there do not exist Lorentz-invariant gauge conditions, which generate Faddeev-Popov Lagrangians that are gauge invariant or such that the Faddeev-Popov fields are free fields. (SDF)

6640 SCALAR SUPERFIELD DYNAMICS FROM THE ARNOWITT-NATH SUPERGEOMETRY. Woo, G. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3069. Lett. Nuovo Cim.; 13: No. 14, 546-550(2 Aug 1975).

From an extension of global supersymmetry to a local gauge symmetry, a general curved superspace geometry is found to be nondynamical and flat in space-time but curved in other sectors. Important geometrical quantities are calculated to exhibit features of this geometry and are used to find the motion of a scalar superfield. The standard equation of motion is obtained for a limiting metric. (SDF)

6641 NONLINEAR ELECTRODYNAMICS IN THE NEWMAN-PENROSE FORMALISM. Bicak, J. (Karlova, Univ., Prague); Slavik, J. Acta Phys. Pol., Ser. B; B6: No. 4, 489-508(1975).

An approach to nonlinear electrodynamics by means of the spin-coefficient formalism of Newman and Penrose is presented. The field equations are rewritten in the Newman-Penrose form, and their spherically symmetric solutions are discussed. An approximation procedure, suitable for treating radiation problems in nonlinear electrodynamics, is then suggested on the basis of an analysis of the Maxwell electrodynamics with sources. Since the field equations are nonlinear, wave tails will in general develop. This is illustrated in detail using an example of the approximate solution, representing a radiating dipole in the zero approximation. Conserved quantities, analogous to those discovered by Newman and Penrose in Maxwell's and Einstein's theories are found for a large class of nonlinear theories of electrodynamics. Their number depends on the choice of a particular theory — it is greater than, or equal to 16 for theories satisfying the correspondence principle with Maxwell's theory. (auth)

6642 SOME EXACT SOLUTIONS FOR ONE-DIMENSIONAL SELF-INTERACTING SYSTEMS IN QUANTUM FIELD THEORIES. DePuy, R. J. Clemson, SC; Clemson Univ. (1975). 167p. University Microfilms Order No. 75-22,088.

Thesis (Ph. D.).

Particular positive or negative frequency solutions of the field equation, $(d^2/dt^2 + m^2)\mathrm{phi/sub\ q\ lambda/} + \mathrm{lambda\ phi/sub\ q\ lambda//sup\ 2q+1/}$ equals 0, for which q not equal to 0, -1 are used in the study of one-dimensional quantum field theories. The commutator, [phi/sub q lambda/,d phi/sub q lambda//dt]/sub -/ equals 1, is not applied because phi/sub q lambda/ is required to be a general solution. The commutator, [phi/sub q lambda//sup (+)/(t),phi/sub q lambda//sup (-)/(t)]/sub -/ equals 1, cannot be applied to the particular solutions considered. The system is quantized by requiring that [phi/sub q lambda//sup (+)/(0),phi/sub q lambda//sup (-)/(0)] /sub -/ equals 1 in analogy with the quantization procedure prescribed for free fields. This quantization procedure leads to a propagator which is not invariant with respect to time translations. Hence any connection between the procedure for quantizing nonlinear particular solutions and the linear canonical quantization formalism remains obscure. General solutions of the field equation, $(d^2/dt^2 + m^2)\mathrm{phi} + \mathrm{lambda\ phi^3}$ equals 0, are patterned after solutions obtained by the method of successive approximations. These solutions process terms containing polynomial factors in the independent variable, t, known as secular terms which account

for the unboundedness of the solutions for large magnitudes of the independent variable. Therefore the differential equation and its solution complete with secular terms are modified by making structural changes in both and by expanding the mass in operator-valued terms. The constituent operators of the solution and mass are chosen such that the secular terms are eliminated. The higher order terms in the mass operator are rewritten in terms of the field solution and its first derivative. (Diss. Abstr. Int., B)

Gravitation and General Relativity

Refer also to abstracts 6167, 6365, 6407, 6410, and 6640.

6643 (CNRS-CPT-75-P-698) IS PHYSICAL SPACE UNIQUE OR OPTIONAL. Ekstein, H. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). Feb 1975. 20p. (CONF-750245-1). Dep. NTIS (US Sales Only) $4.50.

From colloquium in the philosophy of science; Boston, Massachusetts, USA (Feb 1975).

Starting from a fixed flat space results are found equivalent to the general theory of relativity, not only with respect to specific gravitational effects, but an operationally testable version of the Einstein equivalence principle is derived from special relativity and the acceleration group. The main assertions are: The fixed space-time S_F is neither incompatible with nor made superfluous by the Einstein theory. S_F is experimentally explorable, unique, and probably identical with Minkowski space, M. The dynamical space S_D is largely optional. It can be chosen to be M, but the natural choice is Einstein pseudo-Riemannian manifold. (JFP)

6644 (KFKI-75-14) EXTENSION OF COVARIANCE. Sebestyen, A. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1975. 28p. Dep. NTIS (US Sales Only) $5.00.

An extension of the principle of covariance for internal degrees of freedom is considered. The conditions for a system to be isolated are given. From these the field equations and the equations of motion are deduced. As an application the Keplerian motion and the shift of the perihelion are derived. (auth)

6645 MODIFICATIONS OF GENERAL RELATIVITY THEORY (GRT) IN VIEW OF THE EINSTEINIAN GENERALIZATION OF GRAVITATIONAL SOURCES AND PHYSICAL (3 + 1)-SPLITTING. Ivanitskaya, O. S.; Mityanok, V. V. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 3, 75-82 (1975). (In Russian)

An analysis is given of the physical structure of an additional anomaly in fields of Schwarzshild-de Sitter and Reisner-Nordstreom, which demonstrate the applicability of supplemental anomalies of $Ap^3/2$ m and $q^2/2$ mp to this Newtonian approximation of GRT. This approximation combines an approach to absolute simultaneity with the Einsteinian generalization of the concept of a gravitational mass, in these cases---by introducing into a generalized, Poisson equation the gravitational masses of the electrostatic field and vacuum, which depend respectively on the charge and cosmological constant. (SJR)

6646 EFFECTS OF CHARGES, ANGULAR MOMENTA, AND MAGNETIC FIELDS OF BODIES ON THEIR TRANSLATIONAL MOTION IN THE GENERAL THEORY OF RELATIVITY. Ryabushko, A. P. (Belorussian Inst. of Mechanization of Agriculture, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 4, 63-71(1975). (In Russian)

The effects of the electric charges, intrinsic rotation, and magnetic fields of the dipole type of bodies of comparable mass on their translational motion were examined in the framework of the post-Newton approximation of the general theory of relativity. The vector effects, responsible by the existence for the interaction of gravitational and electromagnetic fields of the bodies, were discussed and evaluated. On this basis plans were proposed for two new experiments for verification of the general theory of relativity. (tr-auth)

6647 CONNECTION BETWEEN EINSTEIN SURFACE EQUATIONS, RAYCHAUDHURI EQUATION AND THE INTRINSIC GEOMETRY OF NULL HYPERSURFACES. Sokolowski, L. M. (Jagellonian Univ., Krakow). Acta Phys. Pol., Ser.; B6: No. 5, 657-660(1975).

If teleparallelism is chosen as an affine connection on a null hypersurface V_3^4, then expansion θ and distortion $|\sigma|$ may be represented on it in terms of intrinsic geometry of the V_3^4. The Einstein surface equations together with the Raychaudhuri equation for θ yield an equation which restricts the intrinsic geometry of that null hypersurface. (auth)

6648 CONNECTION OF THE PAPAPETROU PSEUDOTENSOR AND THE BEL-ROBINSON SUPERENERGY TENSOR. Yefremov, A. P. (Peoples' Friendship Univ., Moscow). Acta Phys. Pol., Ser.; B6: No. 5, 667-671(1975).

The expansion of the Papapetrou pseudotensor in the Riemann normal coordinates is obtained in the zeroth, first, and second orders in the coordinates. Pure gravitational terms appear only in the second order and the corresponding coefficient of the expansion is a tensor of the fourth rank. Being symmetrized, this tensor exactly coincides with the Bel-Robinson superenergy tensor which can be hence interpreted as the relative energy-momentum density of the gravitational field. (auth)

6649 PHYSICAL EQUIVALENCE OF THE POINT AND INSTANT FORMS OF THE RELATIVISTIC DYNAMICS. Sokolov, S. N. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 24: No. 2, 236-241(Aug 1975). (In Russian)

The unitary transformation connecting the point and instant forms of the relativistic dynamics is constructed. It proves their complete physical equivalence. (auth)

6650 QUADRATIC LAGRANGIANS AND MASSIVE GRAVITONS. Poznanin, P. L. Izv. Vyssh. Uchebn. Zaved., Fiz.; No. 6, 15-20(1975). (In Russian)

By series expansion of quadratic Lagrangians by small additions to the two-dimensional metrics, the Lagrangian of the free gravitational field was obtained (first term of the expansion) which by exchange of the field constants reduces to the sum of the standard Lagrangians determining the massless and massive scalar and tensor fields. The independent variation of the Lagrangians corresponding to the massive scalar and tensor fields is possible only in the presence of some relation between the coupling constants in the quadratic Lagrangians. (tr-auth)

6651 GAUGE A-FIELD AND THE STRONG GRAVITY. Minkevich, A. V.; Kudin, V. I. (Belorussian State Univ., Minsk). Acta Phys. Pol., Ser.; B6: No. 5, 661-666(1975).

The system of the interacting gravitational field and the gauge A-field, introduced earlier, is considered in the static, spherically symmetric case. In the asymptotical approximation it is shown that the gauge A-field behaves as a short-range one with some effective mass, and that the gravitational potential together with the usual long-range term has also the short-range term, typical for the strong gravity. (auth)

6652 NONSTATIC CHARGED FLUID DISTRIBUTIONS IN GENERAL RELATIVITY. Banerjee, A.; De, U. K. (Jadavpur Univ., Calcutta). Acta Phys. Pol., Ser.; B6: No. 3, 335-340 (1975).

Solutions for two different models of nonstatic charged fluid distributions are given. One of them exhibits cylindrical symmetry, while the other may be considered to be plane symmetric. In both solutions it was shown that once the contraction starts, the collapse to a singularity becomes accelerated and the entire collapse occurs within a finite proper time. (auth)

6653 I. TIME-DEPENDENT ACCRETION DISKS AROUND COMPACT OBJECTS. II. Theoretical Frameworks for Analyzing and Testing Gravitation Theories. Lightman, A. P. Pasadena, CA; California Inst. of Tech. (1974). 280p. University Microfilms Order No. 74-24,448.

Thesis (Ph. D.).

The theory of time-independent accretion disks around compact objects is developed, generalizing the stationary models of various authors to allow time dependence on the radial-flow time scale. Equations are derived for the time evolution of matter surface density SIGMA and for implicit expressions of relevant disk variables in terms of SIGMA. Analytic and numerical studies of these equations yield numerical models of mass accretion from a disk onto a compact object and a discovery of the unstable nature of the "inner region" of the disk, causing a breakdown of current accretion disk models. Theoretical frameworks for analyzing and testing gravitation theories are developed for both nonmetric and metric theories. Highly precise experimental confirmation of the Weak Equivalence Principle is shown to be deadly if not fatal evidence for ruling out all nonmetric theories of gravity. (Diss. Abstr. Int., B)

6654 STRUCTURE OF GENERAL RELATIVITY WITH A NUMERICAL ILLUSTRATION: THE COLLISION OF TWO BLACK HOLES. Smarr, L. L. Austin, TX; Univ. of Texas (1975). 210p. University Microfilms Order No. 75-16,738.

Thesis (Ph. D.).

The splitting of spacetime into space and time is analyzed by abstract methods, coordinate methods, and numerical computer methods. General relativity is assumed to be the correct theory of gravity and the Einstein field equations are studied in their canonical form. A comparison is made of the initial value and

evolution equations for gravity in different formalisms (ADM, geometry of spacelike hypersurfaces, timelike congruences). These equations are then illustrated by a number of cosmological and black hole spacetimes. A study of coordinate conditions is undertaken. The axisymmetric (non-stationary and non-spherical) Einstein equations are discussed, and it is shown how to set up a numerical computer program to integrate these equations starting with a given initial data set. Various applications of this computer approach are discussed: collapse of rotating non-spherical stars, "runaway" collapse, and head-on collisions of black holes. All of these situations would involve generation of gravitational radiation from the formation of black holes. The particular case of two nonrotating black holes colliding head-on is chosen as a test case for the computer. The initial value problem is reviewed and then a computer program is written to generate the spacetime. This generation involves solving four coupled quasilinear hyperbolic (evolution) equations and one linear elliptic equation (maximal slicing) on each spacelike sheet. The numerical difficulties are discussed and graphical methods are used to present the result of the computations. (Diss. Abstr. Int., B)

6655 FURTHER REMARK ON THE UNCERTAINTY RELATION OF I_4 AND ϕ. Papaloucas, L. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 14: No. 4, 113-114(27 Sep 1975).

The concepts of angle and phase operators, a problem in the understanding of the fundamentals of quantum mechanics are discussed. Possible applications to coherent states in laser physics, superconductivity, and superfluidity, and in connection with the energy–time uncertainty relation are noted. (JFP)

6656 INTEGRAL CONDITIONS, BOUNDARY SURFACES, AND MATTER IN GENERAL RELATIVITY. Treder, H. J. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 32: No. 2, 159-160(1975).

Starting from a generalization of the integral definition of the mass m of stationary gravitational fields given previously, the integral conditions, boundary surfaces, and matter are treated in general relativity theory. (JFP)

6657 BOUNDARIES OF SPACE–TIME AND SINGULARITIES IN GENERAL RELATIVITY. von Borzeszkowski, H. H.; Kasper, U. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 32: No. 2, 146-158(1975).

In general relativity, a catalog of boundary definitions is considered. Arguments are presented which show that, in general, the complete description of a physical situation does not admit "singular coordinate transformations" and other extension procedures which change the physical character of space-times; according to Reichenbach, a complete description is equivalent to the fixation of the combination: topology (T) plus metric (M). Therefore, any boundary which cannot be "removed" by procedures which maintain topology has to be considered a genuine boundary (singularity). Some boundaries of the vacuum theory of general relativity are discussed. (auth)

6658 WHEN CAN GRAVITATION HAVE A STRONG INTERACTION. Treder, H. J. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 32: No. 3, 238-240 (Mar 1975). (In German).

Equations describing the conditions under which gravitation has a strong interaction are derived. (JSR)

6659 FIELD EQUATIONS OF TREDER'S GRAVITATIONAL THEORY WHICH ARE DERIVABLE FROM A VARIATIONAL PRINCIPLE. III. Kasper, U. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 32: No. 2, 115-118(1975).

In Treder's theory of gravitation the active gravitational (Schwarzschild) mass is, generally speaking, different from the inertial (rest) mass of a stationary space-bounded field producing system. One considers a certain class of field equations and it is shown that the relative deviation of the inertial (rest) mass from the Schwarzschildian mass is very small ($\leq 1/15$). (auth)

6660 TOWARD A UNIFIED FIELD THEORY OF GRAVITATION AND STRONG INTERACTIONS. Sarfatti, J. (International Center for Theoretical Physics, Trieste, Italy). Found. Phys.; 5: No. 2, 301-307(Jun 1975).

The chiral SU(3) quark model is shown to be a consequence of general relativity for Petrov type Id space–times, in much the same way that the Dirac equation is a consequence of special relativity. (auth)

6661 NULL CANONICAL FORMALISM. II. Einstein Field. Wodkiewicz, K. (Univ., Warsaw). Acta Phys. Pol., Ser. B; B6: No. 4, 521-527(1975).

The canonical formalism on null hypersurfaces for the Einstein field is formulated. Using the analogy between Maxwell's theory and gravitation theory, a set of the Poisson bracket relations for the null Weyl tensor components is obtained. The asymptotic properties of the theory are investigated. The Poisson bracket relations for the Bondi news-functions are computed. The Hamiltonian form of the asymptotic Einstein equations on terms of the news-functions is found. (auth)

6662 GAUSS–CODAZZI EQUATIONS AND FIELD EQUATIONS FOR A SPECIAL CASE OF NULL HYPERSURFACES IN THE THEORY OF GRAVITATION. Sokolowski, L. M. (Jagellonian Univ., Krakow). Act Phys. Pol., Ser. B; B6: No. 4, 529-536(1975).

It is shown that on every null hypersurface a linear connection exists which is both metric and integrable, but not symmetric in general. Using this connection the Gauss-Codazzi equations are derived in the case when the null hypersurface admits this connection to be symmetric. Then these equations are very simple and are used to prove that the Einstein constraint equations impose no restrictions on the inner geometry of those particular null hypersurfaces. (auth)

6663 EINSTEIN–CARTAN EQUATIONS IN ASTROPHYSICALLY INTERESTING SITUATIONS. I. The Case of Spherical Symmetry. Kuchowicz, B. (Univ., Warsaw). Acta Phys. Pol., Ser. B; B6: No. 4, 555-575(1975).

The Einstein-Cartan equations (general relativity plus spin in a manifold with curvature and torsion) are written explicitly for the case of sperical symmetry. In this case there may exist, at most, eight nonvanishing independent components of the torsion tensor when one does not assume the "classical description" of spin. It is shown explicitly, by giving various nonequivalent ways to do it, how exact solutions of spherical symmetry for matter-filled regions may be generalized from general relativity into the Einstein-Cartan theory. A classification of cosmological models with the Robertson-Walker metric in the Einstein–Cartan theory is given. (auth)

6664 NONLINEARITY AND TORSION. Krechet, V. G.; Ponomarev, V. N. (Moscow State Univ.). Teor. Mat. Fiz.; 25: No. 1, 141-144(Oct 1975). (In Russian).

Dynamics of the self-gravitating spinor wave fields in spacetime with torsion is considered. It is shown that the torsion can induce the minimal (of the ψ^3 type) nonlinearity of the spinor equations as well as compensate for it. (auth)

REACTOR TECHNOLOGY AND REGULATION

6665 (CONF-750411-82) DECOMMISSIONING IN THE MATURE NUCLEAR POWER INDUSTRY. Anderson, F. H.; Slansky, C. M. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). 1975. 4p. Dep. NTIS $4.50.

From European nuclear conference; Paris, France (21 Apr 1975).

Procedures for decommissioning a nuclear power plant or a spent fuel reprocessing plant are described. (DCC)

6666 (DP-REPORT-751) HIGH TEMPERATURE GAS COOLED REACTOR: A PROCESS HEAT/ELECTRICAL ENERGY SOURCE FOR A LARGE STEELWORKS. Dragon Project. Hosegood, S. B.; McIver, R. F.; Mancini, G.; Hawkes, D. A.; Pochin, C. W. D.; Wild, R. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). May 1971. 44p. (CONF-710573–1). Dep. NTIS (US Sales Only) $5.25.

From meeting on alternative routes to steel; London, UK (5 May 1971).

The possible types of direct reduction and steel-making processes that could be integrated into a plant complex using a high temperature gas cooled reactor as the process heat and electrical energy source are discussed, and a suitable overall process route is suggested using today's technological knowledge. An attempt has been made to compare the cost of steel products from such a complex with those from a traditional blast furnace/oxygen steel-making route. The development problems to be encountered, and possible solutions to these problems, are discussed together with some thoughts on future trends in technological and economic factors. 14 references. (auth)

6667 (ERDA-tr-78) ENGINEERING PROBABILITY CALCULATIONS IN NUCLEAR REACTOR DESIGN. Klemin, A. I. 1973. Translation by W. J. Grimes of Inzhenerne veroyatnostne raschety pri proyektirovanii yadernykh reaktorov, Moscow, Atomizdat, 1973. 444p. Dep. NTIS $12.75.

The book is a manual to be used by designers, analysts, researchers, and production workers in solving the practical problems which arise at all stages in the construction of a nuclear reactor, using methods of the theory of probability and mathematical statistics. The book deals with problems relating to the following areas: quantitative evaluation of reliability and radiation safety of nuclear reactors, planning and analysis of the results of tests and experiments forming the basis of nuclear reactor design, estimation of the accuracy of computational characteristics, statistical analysis of the manufacturing accuracy of reactor structures, and choice of solutions under conditions of indeterminacy. 130 references. (auth)

6668 (KFK-EXT-8/75-2) REGENT: SEVENTH SEMIANNUAL PROGRESS REPORT, OCTOBER 1974–MARCH 1975. Schlechtendahl, E. G. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Aug 1975. 43p. (In German). Dep. NTIS (US Sales Only) $5.00.

The project REGENT (German acronym for CAD, Computer Aided Design) was started early 1972 by the Institut fuer Reaktorentwicklung. The seventh semiannual progress report summarizes the results achieved up to March 31, 1975, in particular with respect to the development of the REGENT system nucleus and its application for the first REGENT subsystems. The development of the REGENT nucleus and of a graphical subsystem has become a part of the project CAD since mid 1974. Other subsystems are being developed within the framework of the project PNS (Project Nuclear Safety). (auth)

6669 (NP-20603) ENERGY INPUTS AND OUTPUTS FOR NUCLEAR POWER STATIONS. Research Report ERG 005. Chapman, P. F.; Mortimer, N. D. (Open University, Milton Keynes (UK). Energy Research Group). Dec 1974. 63p. Dep. NTIS (US Sales Only) $6.25.

A method of analyzing nuclear power systems so that some of the physical consequences of decisions can be understood is described. The energy implications of building reactors are investigated. (UK)

6670 CHEMICAL ASPECTS IN THE PRODUCTION OF NUCLEAR ENERGY. Ind. Quim. (Buenos Aires); No. 231, 10-16(1974). (In Spanish)

As an introduction to a consideration of the chemical aspects of nuclear power generation, the general types of power reactors, steam generation, and the fuel cycle are briefly reviewed. The nuclear plan of the CNEA is summarized. (JSR)

6671 PRODUCTION OF NUCLEAR ENERGY. Schmidt, G. Brennst.-Waerme-Kraft; 27: No. 4, 141-146(Apr 1975). (In German)

A general review is given of the development of nuclear energy in Germany and of the development projects under study. The special projects now being studied by various countries are summarized. The environmental and safety aspects of nuclear power are considered. The fuel cycle is described. The treaties and international organizations dealing with nuclear energy are described. (24 references). (JSR)

6672 VERY HIGH TEMPERATURE REACTOR (VHTR) TECHNOLOGY. Jones, A. R. (Westinghouse Astronuclear Lab., Pittsburgh). pp 329-337 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A nuclear reactor with the capability of providing heat in helium at 1700 to 1850°F is attractive in a broad spectrum of high performance systems. Two variants of a very high temperature reactor (VHTR) concept, which have been explored in some detail, are described. The purpose of the Westinghouse Astronuclear Laboratory (WANL) design studies has been to evaluate feasibility and practicality and to provide characteristic data. In order to accomplish this, a reference application was selected for each of the two classes--mobile and process heat. The study applications selected were the 2000 ton SES for mobile and coal conversion to synthetic hydrocarbons for process heat. The effort to date has illustrated the feasibility of the VHTR concept, produced typical conceptual designs, identified sources of the basic technology needed for the remaining development effort, identified an R and D plan to produce the engineering data for demonstration units and produced cost estimates therefor. The commonality of the R and D effort is illustrated in that roughly three quarters of the total effort is applicable to both classes. Obviously, the demonstration units are separate and distinct although each demonstration program could make important contributions to the other class. (auth)

6673 ECONOMICS OF THE PRODUCTION OF LIQUID FUEL AND FERTILIZER BY THE FIXATION OF ATMOSPHERIC CARBON AND NITROGEN USING NUCLEAR POWER. Baron, S. (Burns and Roe, Inc., Oradell, NJ); Steinberg, M. pp 842-848 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The economics of using reactor power during off-peak period for the production of H_2 and fixation of C to produce methanol and the fixation of N_2 for the production of NH_3 are reviewed to show that it is economically feasible with the current prices of fossil fuels. The incremental energy costs for synthesis processes are summarized. Methanol and ammonia production and economics are analyzed. An additional economic advantage would be the possible production of single cell protein. (JSR)

6674 PROCESS APPLICATIONS OF A VERY HIGH TEMPERATURE NUCLEAR REACTOR (VHTR). Farbman, G. H.; Brecher, L. E. (Westinghouse Electric Corp., Pittsburgh). pp 1199-1204 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The VHTR for process applications appears to have a very high probability of making a positive contribution to meeting the nation's energy needs in the future. The approach of considering the nuclear reactor, integrated with a hydrogen producing water decomposition plant, provides a product (heat, electricity, and hydrogen) that is common to a large number of processes. Treating this nuclear hydrogen system as a standardized design to provide "process utility" requirements minimizes the problem of interfacing a nuclear heat source with a myriad of ultimate user processes. The application studies that have been performed to date have been preliminary. They have, however, indicated that, for the long term, the production of hydrogen by the decomposition of water, using nuclear energy from the VHTR, can be attractively economic and can result in a practical system with minimal impact on our nation's resources and environment. The commercialization of the nuclear process could provide a long term contribution to the nation's energy requirements by the use of hydrogen, for example, as a direct fuel, or as a feedstock in processes for the essentially

complete conversion of coal to premium fuels or petrochemical feedstocks, or for the direct reduction of iron ore, or for the manufacture of ammonia and fertilizers. (LK)

6675 9TH WORLD ENERGY CONFERENCE, DETROIT, MICHIGAN, SEPTEMBER 22–27, 1974. Preprints. Division 6: Utilization of Energy. London; World Energy Conference (1974). vp. (In English and French). (CONF-740910-P6).

Of the twenty-eight papers presented concerning world energy resources only one was in scope for NSA. A separate abstract is provided for that paper. (DCC)

For an abstract of an individual paper see: 6676.

6676 DESALINATION PLANT AND EXTRACTION OF MINERAL PRODUCTS FROM SEAWATER BY MEANS OF A NUCLEAR POWER PLANT. de Simone, J. C.; Tabourier, B. Paper 6.2-2, 13p. of 9th World Energy Conference. London; World Energy Conference (1974). (In French)

From 9th world energy conference; Detroit, Michigan, USA (22 Sep 1974). See CONF-740910-P6.

The industrial complex described comprises a sea water desalination plant associated with a unit for the extraction of chemicals through the use of residual brines. The plant comprises a 1,800 thermic MW nuclear boiler (pressurized water reactor) producing 360 electrical MW, a 1,400 thermic MW desalination plant, and a unit for the extraction of chemicals. The total electrical power leaves a 40 MW margin which could be used for fresh water distribution. (auth)

6677 CONFERENCE ON NUCLEAR POWER AND APPLICATIONS IN LATIN AMERICA, SEPTEMBER 28–OCTOBER 1, 1975, MEXICO CITY, MEXICO. Farmakes, R. (ed.). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., vp(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

Forty-six papers covering the topics of nuclear power, the fuel cycle, and isotopes and radiation were presented. These papers are all listed by title in NSA. Four papers are listed by title in ERA. (JWR)

For abstracts of individual papers see: 4950–4954, 4975, 5007, 5008, 5098, 5109, 5110, 5580, 5606, 5616, 5655, 5656, 5733, 5875–5877, 6077, 6678, 6679, 6710, 6712, 6754, 6775, 6840–6845, 6875, 6876, 6879–6887, 6896, and 6897.

6678 INFORMATION EXCHANGE ON NUCLEAR POWER PLANT CONSTRUCTION. Palmeter, S. B. (GPU Service Corp., Parsippany, NJ). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 20-21(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6679 PROCESS HEAT FROM AN HTGR FOR PETROLEUM REFINING AND PETROCHEMICAL PRODUCTION. Kato, W. Y.; Bozorgmanesh, H. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 24(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6680 WHERE DO WE GO FROM HERE. Wyman, M. E. (Univ. of Illinois, Urbana). Nucl. Technol.; 27: No. 1, 29-33 (Sep 1975).

Nuclear engineering, being a new area, produces only one-third as many bachelor's degrees per PhD as does electrical engineering. As the field matures, the bachelor's degree production will increase. In adding a bachelor's program at a school already having a master's program, it may be necessary to revamp a master's degree requirement. It will be necessary to cope with a variety of bachelor's background preparation in stabilizing the master's-level professional engineering degree. Suggestions for the bachelor's and master's curricula include: (1) inclusion of courses for freshmen and sophomores to stimulate student interest (2) developing a variable content course to permit trial courses and temporary course needs without formal course submission (3) increasing the synthesis content (4) removal of certain curricula distortion (5) supporting of only undergraduate accreditation (6) the development of certain student attitudes to make them more acceptable as employees (7) developing a curricula blend of master's and PhD courses that can support both efforts. Suggestions for PhD programs include: (1) making research topics more relevant (2) allowing project-oriented theses (3) discouraging off-campus research (4) developing attitudes in the students so that they will be more responsive to the needs of their employers and the field. The need and responsibility for explaining and convincing the public of the importance and usefulness of nuclear power is emphasized. (auth)

6681 CURRENT STATUS OF NUCLEAR ENGINEERING EDUCATION. Palladino, N. J. (Pennsylvania State Univ., University Park). Nucl. Technol.; 27: No. 1, 18-28 (Sep 1975).

The 65 colleges and universities offering undergraduate degrees in nuclear engineering and the 15 schools offering strong nuclear engineering options are, in general, doing a good job to meet the current spectrum of job opportunities. But, nuclear engineering programs are not producing enough graduates to meet growing demands. They currently receive little aid and support from their customers (industry and government) in the form of scholarships, grants, faculty research support, student thesis and project support, or student summer jobs. There is not enough interaction between industry and universities. Most nuclear engineering programs are geared too closely to the technology of the present family of reactors and too little to the future breeder reactors and controlled thermonuclear reactors. In addition, nuclear engineering programs attract too few women and members of minority ethnic groups. Further study of the reasons for this fact is needed so that effective corrective action can be taken. Faculty in nuclear engineering programs should assume greater initiative to provide attractive and objective nuclear energy electives for technical and nontechnical students in other disciplines to improve their technical understanding of the safety and environmental issues involved. More aggressive and persistent efforts must be made by nuclear engineering schools to obtain industry support and involvement in their programs. (auth)

6682 HISTORY OF NUCLEAR ENGINEERING CURRICULA. Murphy, G. (Iowa State Univ., Ames). Nucl. Technol.; 27: No. 1, 11-14 (Sep 1975).

With the realization that nuclear energy had a vast potential for peacetime development, universities throughout the country began to develop courses in nuclear energy. A pioneering educational effort was necessary because there was an inadequate number of trained faculty, no established curricula, no textbooks, and very little suitable equipment. Nevertheless, by the early 1950's, several programs in nuclear science and engineering were beginning to provide instruction to potential nuclear engineers. At that time, the American Society for Engineering Education (ASEE) established a nuclear committee to cooperate with the U. S. Atomic Energy Commission (AEC) in nuclear education matters. With the financial support of the AEC, textbook material was developed, faculty training programs were instituted, and funds were made available for equipment. Because of the large interest shown in the field, many colleges and universities began to develop nuclear engineering curricula. After a few years, the need arose for general guidelines in curricular development. This led to the development of a Committee on Objective Criteria in Nuclear Engineering Education in which ASEE and the American Nuclear Society cooperated with the support of AEC. The committee report emphasized basic science, nuclear energy concepts, and nuclear technology, which have continued to be the significant components of a nuclear engineering curriculum. The last ten years have brought increased emphasis on BS programs, the introduction of extensive computer-based instruction, and an increasing emphasis on the engineering aspects of nuclear reactor power systems. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 5662, 6805, 6812, 6814, 6816, 6821, 6822, 6824, 6830, 6836, 6875, and 6888.

6683 (BN-TOP-3(Rev.3)) PERFORMANCE AND SIZING OF DRY PRESSURE CONTAINMENTS. (Bechtel Power Corp., San Francisco, Calif. (USA)). Aug 1975. 38p. Bechtel Power Corp., San Francisco.

6684 (CONF-750360-2) CRACKED PELLET GAP CONDUCTANCE MODEL: COMPARISON OF FRAP-S CALCULATIONS WITH MEASURED FUEL CENTERLINE TEMPERATURES. MacDonald, P. E.; Broughton, J. M. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1975. Contract AT(10-1)-1375. 20p. Dep. NTIS $4.50.

From OECD Halden reactor project conference; Geilo, Norway (17 Mar 1975).

Fuel pellets crack extensively upon irradiation due both to thermal stresses induced by power changes and at high burnup, to accumulation of gaseous fission products at grain boundaries. Therefore, the distance between the fuel and cladding will be circumferentially nonuniform; varying between that calculated for intact operating fuel pellets and essentially zero (fuel segments in contact with the cladding wall). A model for calculation of temperatures in cracked pellets is proposed wherein the effec-

tive fuel to cladding gap conductance is calculated by taking a zero pressure contact conductance in series with an annular gap conductance. Comparisons of predicted and measured fuel centerline temperatures at beginning of life and at extended burnup are presented in support of the model. 13 references. (auth)

6685 (CONF-750958-2) BEHAVIOR OF IRRADIATED LWR FUEL PELLETS DURING THERMAL TRANSIENTS. Kelman, L. R.; Rest, J.; Seitz, M. G.; Gehl, S. M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 3p. Dep. NTIS $4.00.

From 3rd annual water reactor safety meeting; Washington, District of Columbia, USA (29 Sep 1975).

Prediction of the behavior of LWR fuel rods and fission products under off-normal and accident conditions requires a physically realistic description of fuel swelling and fission-product release that currently does not exist. To satisfy this need, a program was initiated at ANL approximately a year ago with the prime objective of developing a comprehensive computer-base model that describes the release of fission products as a function of thermal transients anticipated in hypothetical accident situations. This model will be incorporated into ANC's FRAP accident-analysis code system. The analytical effort is supported by data developed from characterization of irradiated LWR fuel and from out-of-reactor transient heating tests of irradiated LWR fuel under conditions that simulate hypothetical LWR accidents. (auth)

6686 (GEAP-20950) ADVANCED STEAM CYCLES FOR LIGHT WATER REACTORS. Final Report. Mitchell, R. C. (General Electric Co., San Jose, Calif. (USA)). Jul 1975. Contract E(04-3)-189. vp. Dep. NTIS $7.60.

An appraisal of the potential of adding superheat to improve the overall LWR plant cycle performance is presented. The study assesses the economic and technical problems associated with the addition of approximately 500^0F of superheat to raise the steam temperature to 1000^0F. The practicality of adding either nuclear or fossil superheat to LWR's is reviewed. The General Electric Company Boiling Water Reactor (BWR) model 238-732 (BWR/6) is chosen as the LWR starting point for this evaluation. The steam conditions of BWR/6 are representative of LWR's. The results of the fossil superheat portion of the evaluation are considered directly applicable to all LWR's. The review of nuclear superheat shows that, in spite of the potential of a nuclear superheater to provide a substantial boost to the LWR cycle efficiency, nuclear superheat offers little promise of development at this time. There are difficult technical problems to resolve in the areas of superheat fuel design and emergency core cooling. The absence of a developed high integrity, high temperature fuel for operation in the steam/water environment is fundamental to this conclusion. Fossil superheat offers the potential opportunity to utilize fossil fuel supplies more efficiently than in any other mode of central station power generation presently available. Fossil superheat topping cycles evaluated included atmospheric fluidized beds (AFB), pressurized fluidized beds, pressurized furnaces, conventional furnaces, and combined gas/steam turbine cycles. The use of an AFB is proposed as the preferred superheat furnace. Fossil superheat provides a cycle efficiency improvement for the LWR of two percentage points, reduces heat rejection by 15 percent per kWe generated, increases plant electrical output by 54 percent, and burns coal with an incremental net efficiency of approximately 40 percent. This compares with a net efficiency of 36–37 percent which might be achieved with an all-fluidized bed fossil superheat plant design. (auth)

6687 (NEDO-12552) NONDESTRUCTIVE EXAMINATION OF PLUTONIUM RECYCLE FUEL RODS IRRADIATED TO 30,000 MWd/t. Bishop, D. M.; Baily, W. E. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Dec 1974. 94p. General Electric Co., San Jose, CA.

The results obtained from nondestructive examination of eleven mixed oxide fuel rods irradiated in the Big Rock Point reactor to peak burnups between 23,000 to 30,000 MWd/t are presented. Detailed performance results including fuel rod dimensional changes, fuel densification, and swelling of solid, dished, and annular fuel pellets are discussed. The in-pile performance of the mixed oxide fuel was favorable. 14 references. (auth)

6688 (NEDO-20533) GENERAL ELECTRIC MARK III PRESSURE SUPPRESSION CONTAINMENT SYSTEM ANALYTICAL MODEL. Bilanin, W. J. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Jun 1974. 100p. General Electric Co., San Jose, CA.

The analytical models used to simulate the short-term transient response of a Mark III pressure suppression containment to a postulated loss-of-coolant accident are presented. The governing equations are defined together with derivations of the simultaneous differential equations that simulate the transient conditions in the containment. The numerical techniques used to integrate these equations are discussed. All modeling and boundary condition assumptions are described and discussed. Model results are compared with experimental data from the General Electric Company's large-scale Mark III test facility; the comparisons indicate that the model is conservative. This conservatism is reflected in the design parameters that are being specified for those containment systems using the Mark III concept. 11 references. (auth)

6689 WATERSIDE FLOW PROBLEMS IN BOILERS. Firman, E. C. Combustion; 47: No. 1, 21-28(Jul 1975).

A broad picture is given of the practical problems associated with steam and water flows and of the methods being used to study them. (auth)

6690 STUDIES ON THE EXPANSION OF WET STEAM IN NUCLEAR TURBINES. Bonzani, G.; Martelli, F.; Senis, R. (ENEL, Rome). Termotecnica (Milan); 29: No. 5, 265-282(May 1975).

After a short description of phenomena occurring during the expansion of wet steam in turbine, the related equations are presented. The calculation method is applied to a 1000 MW nuclear plant turbine, and the results are discussed. (auth)

6691 REVIEW OF ADVANCED STEAM CYCLES FOR LIGHT WATER REACTORS. McNelly, M. J.; Mitchell, R. C. (General Electric Co., San Jose, CA). Contract AT(04-3)-189. pp 295-307 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The status of superheating for LWR steam cycles is reviewed. (JWR)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 5662, 6676, 6683–6686, 6689–6691, 6801–6803, 6805, 6807, 6811, 6813, 6814, 6824, 6830, 6833–6836, 6845, 6875, and 6888.

6692 (NEDO-13388) TWO-PHASE FLOW IN BOILING WATER NUCLEAR REACTORS. Lahey, R. T. Jr. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jul 1974. 109p. General Electric Co., San Jose, CA.

Two-phase flow phenomena of interest in boiling water nuclear reactor (BWR) technology are discussed. Basic definitions, notations, and fundamental concepts are described. Various forms of the two-phase conservation equations are derived. Flow regime phenomena and analysis is discussed. Void-quality relations for both bulk and subcooled boiling are derived, and models and correlations for frictional and local two-phase pressure drop are presented. (auth)

6693 (WCAP--7959-A) EFFECT OF AXIAL SPACING ON INTERCHANNEL THERMAL MIXING WITH THE R MIXING VANE GRID. Cadek, F. F.; Dominicis, D. P.; Motley, F. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1975. 76p. PWR Systems Div., Pittsburgh.

Three test series to determine the thermal diffusion coefficient (TDC) for a new type of mixing vane grid (R) are described. The three experiments used axial grid spacings of 13, 26, and 32 in. in a 6 ft. long, 6 x 6 rod bundle. Tests were conducted over a range of thermal-hydraulic conditions similar to those found in a PWR core. The value of thermal diffusion coefficient (TDC) was determined by matching the experimental exit enthalpy distribution to that predicted by the THINC computer code. 5 references. (auth)

6694 (WCAP--8299-A) EFFECT OF 17 X 17 FUEL ASSEMBLY GEOMETRY ON INTERCHANNEL THERMAL MIXING. Motley, F. E.; Wenzell, A. H.; Cadek, F. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jan 1975. 58p. PWR Systems Div., Pittsburgh.

A test to determine the value of the thermal diffusion coefficient (TDC) in the 17 x 17 fuel assembly geometry was conducted. The test section was a 5 x 5 rod bundle with a radial power difference of 4.5 to 1. The rod OD and pitch are identical to the 17 x 17 fuel assembly, as is the mixing vane grid design. The value of thermal diffusion coefficient (TDC) was determined by matching the experimental exit enthalpy distribution to that predicted by the THINC computer code. The mean value of TDC for the 17 x 17 fuel assembly geometry is TDC equals .059. 6 references. (auth)

6695 (WCAP--8317-A) PREDICTION OF THE FLOW-INDUCED VIBRATION OF REACTOR INTERNALS BY SCALE MODEL TESTS. Lee, H. (Westinghouse Electric Corp., Pitts-

burgh, Pa. (USA)). Jul 1975. 73p. PWR Systems Div., Pittsburgh.

It is shown that $1/24$th scale model test results accurately predict the flow-induced vibration and modes of full-size reactor internals. Dimensional analysis principles are reviewed and the similitude requirements for valid model tests of the flow-induced vibration of reactor internals are identified. Test results on reactor internals flow vibration models are presented and compared with plant test results. Reactor internals with neutron pads are shown to vibrate only about one-third as much as internals having a thermal shield. 17 references. (auth)

6696 (WCAP-8587) ENVIRONMENTAL QUALIFICATION OF WESTINGHOUSE NSSS CLASS 1E EQUIPMENT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). 1975. 52p. Westinghouse Electric Corp., Pittsburgh.

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 6666, 6672, 6679, 6768, and 6827.

6697 (DP-REPORT-818) STATUS OF FUELS AND METALS FOR HIGH TEMPERATURE GAS COOLED REACTORS. Dragon Project. Graham, L. W.; Huddle, R. A. U.; Price, M. S. T. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Dec 1972. 31p. (CONF-7210133-1). Dep. NTIS (US Sales Only) $4.75.

From 12th conference on nuclear energy and advanced nuclear reactors; Milan, Italy (14 Dec 1972).

The present status is reviewed of fuels and metallic alloys for High Temperature Gas-Cooled Reactors (HTRs) which are now into the initial commercial phase. The breakthrough for the system stems from the development of coated particle fuel, the successful operation of graphite structures coupled with the demonstration of helium technology on an engineering scale. Current designs and performance of fuel and fuel elements for low enriched and thorium cycle HTRs are discussed. The features which govern the choice of alloys for the primary circuit of present steam cycle HTRs are explained. 101 references. (auth)

6698 (EUR-5363e) FISSION GAS RELEASE FROM HTR FUEL COMPACTS CONTAINING A KNOWN QUANTITY OF FREE FUEL. Klersy, R.; Schurenkamper, A.; Simoni, O. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1975. 34p. Dep. NTIS (US Sales Only) $5.00. EUR FB 120,-.

Fission gas release from HTR fuel compacts containing known quantities of free fuel has been measured during irradiation. The free fuel was present in form of powder, bare kernels and defective coated particles, and the ratio of free fuel to intact particules varied between 0 and 5.10^{-2}. It has been shown that the fission gas release is governed by temperature and depending on the delay constant, λ, of the different isotopes of Kr and Xe. The gas release is strongly influenced by the physical form of the free uranium and also by the retention capability of the graphite matrix. (auth)

6699 (EUR-5368e) INTERACTION BETWEEN UO_2 KERNEL AND PYROCARBON COATING IN IRRADIATED AND UNIRRADIATED HTR FUEL PARTICLES. Drago, A.; Klersy, R.; Simoni, O.; Schrader, K. H. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1975. 30p. Dep. NTIS (US Sales Only) $5.00. EUR FB 100,-.

Experimental observations on unidirectional UO_2 kernel migration in TRISO type coated particle fuels are reported. An analysis of the experimental results on the basis of data and models from the literature is reported. The stoichiometric composition of the kernel is considered the main parameter that, associated with a temperature gradient, controls the unidirectional kernel migration. 12 references. (auth)

6700 (GA-A-13487) STARTUP PHYSICS TESTS AT FORT ST. VRAIN. Ross, S. R.; Brown, J. R.; Nirschl, R. J. (General Atomic Co., San Diego, Calif. (USA)). 20 May 1975. Contract AT(04-3)-633. 30p. (CONF-750607-33). Dep. NTIS $4.50.

From American nuclear society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The results of the physics tests performed to date during the startup testing program are presented, and measured results are compared with predicted values. (auth)

6701 (GA-A-13524) MECHANICAL PROPERTIES OF GRAPHITE FOR HIGH-TEMPERATURE GAS-COOLED REACTORS: A REVIEW. Price, R. J. (General Atomic Co., San Diego, Calif. (USA)). 22 Sep 1975. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

Experimental data on the mechanical properties of reactor graphites (excluding irradiation creep and fatigue) under High-Temperature Gas-Cooled Reactor (HTGR) conditions are reviewed. Based on an assessment of the literature, recommendations are made for design-basis values for the elastic properties and strength of irradiated graphite, and failure criteria are suggested for particular loading conditions. 78 references. (auth)

6702 (GA-A-13010A2) GENERAL ATOMIC QUALITY ASSURANCE PROGRAM, Amendment 2. (General Atomic Co., San Diego, Calif. (USA)). Oct 1975. vp. (GA-LTR-11). General Atomic Co., San Diego, CA.

This report establishes the General Atomic HTGR Quality Assurance Program from which the General Atomic Quality Assurance Manual will be prepared and implemented, and provides the basis of the Quality Assurance Program implemented at General Atomic Company during the design, procurement, manufacturing, construction, and testing phases of an HTGR nuclear steam supply system. (auth)

6703 (GA-A-13592) HTGR FUELS AND CORE DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending August 31, 1975. (General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1975. Contract AT(04-3)-167. 275p. Dep. NTIS $7.60.

Studies of reactions between core materials and coolant impurities, basic fission product transport mechanisms, core graphite development and testing, the development and testing of recyclable fuel systems, and physics and fuel management studies are described. Materials studies include irradiation capsule tests of both fuel and graphite. Experimental procedures and results are discussed and, where appropriate, the data are presented in tables, graphs, and photographs. (auth)

6704 (GULF-GA-A--12802) HTGR GAS TURBINE POWER PLANT PRELIMINARY DESIGN. Koutz, S. L.; Krase, J. M.; Meyer, L. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1973. 35p. (CONF-7404116--1). General Atomic Co., San Diego, CA.

From ASME international gas turbine conference; Zurich, Switzerland (31 Mar 1974).

The preliminary reference design of the HTGR gas turbine power plant is presented. Economic and practical problems and incentives related to the development and introduction of this type of power plant are evaluated. The plant features and major components are described, and a discussion of its performance, economics, development, safety, control, and maintenance is presented. 4 references. (auth)

6705 (RD/B/N-3438) EXAMINATION OF CORROSION ON PRIMARY SELECTOR VALVE BELLOWS. Rickards, G. K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1975. 11p. Dep. NTIS (US Sales Only) $4.50.

The stainless steel bellows of the primary selector valves from the burst can detection system of the Sizewell 'A' reactor were found to have spots of corrosion. These corrosion spots were thought to be caused by the cleaning process employed during manufacture. Samples subjected to the manufacturing cleaning process were examined in the scanning electron microscope equipped with an x-ray energy dispersive analysis system. The corrosion was shown to be associated with the acid cleaning process employed. Deposits were also left on samples not acid cleaned and it is suggested that these have come from contaminated washing water. (auth)

6706 (TRG-Report-2682(R)) PERCON: A FLEXIBLE COMPUTER CODE FOR DETAILED THERMAL PERFORMANCE STUDIES. Boardman, F. B.; Collier, W. D. (UKAEA Reactor Group, Risley). Jul 1975. 29p. Dep. NTIS (US Sales Only) $5.00. UK £1.00.

PERCON is a computer code which evaluates temperatures in three dimensions for a block containing heat sources and having coolant flow in one dimension. The solution is obtained at successive planes perpendicular to the coolant flow and the progression from one plane to the next occurs by the heat to the coolant determining convective boundary conditions at the next plane after making due allowance for any lateral mixing or mass transfer between coolants. The coolant flow may be specified, or alternatively derived by the program to satisfy either a specified overall pressure drop or mixed mean temperature rise. The pressure drop through each coolant is calculated and the flow modified, followed by a repeat of the temperature calculation, until the pressure imbalance between chosen flow channels at chosen axial positions is less than the specified convergence limit. A detailed description of the facilities in the code is given and some cases which have been studied are discussed. 6 references. (auth)

6707 RADIATION EFFECTS ON HEAT TRANSFER IN THE REACTOR CORE AND HEAT EXCHANGERS OF AN HTGR. Mori, Y.; Hijikata, K.; Yamada, Y. (Tokyo Inst. of Tech.). J. Heat Transfer; 97: No. 3, 400-405(Aug 1975).

From winter annual meeting of American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A general and fundamental study of the effect of radiation between duct walls on the heat transfer performance of duct flows of nonradiating gas such as helium is made by an approximate analysis and numerical calculations. Laminar and turbulent flows in a duct simulating a coolant passage in an HTGR and flows in counterflow and parallel-flow heat exchangers in an HTGR heat transfer system are investigated. An approximate analytical solution, based on the assumption that radiation from a point of duct wall produces an effect only on the narrow region opposite the point, agrees well with numerical results. The increase of radiative heat transfer causes a decrease of temperature difference between the duct walls and improves the heat transfer performance. For heat exchangers the heat transfer effectiveness is shown to depend on three nondimensional parameters and can be improved by the increase of these parameters. (auth)

6708 THERMODYNAMIC PARTICULARS OF THE CYCLES AND LAYOUTS OF THE POWER LOOPS OF NUCLEAR ELECTRIC PLANTS WITH HELIUM-COOLED HIGH-TEMPERATURE REACTORS. Gokhshteyn, G. P. (Odessa Order of the Red Banner of Labor Polytechnical Inst.). Izv. Vyssh. Ucheb. Zaved., Energ.; No. 3, 44-48(Mar 1975). (In Russian)

An examination is made of binary He-Co_2 cycles in nuclear electric power plants with helium in the first loop. Schemes are considered with retention of high total efficiency at relatively low temperatures of helium input to the reactor. It is shown that a fuel savings of 17.3% can be achieved by changing from a helium cycle to the binary He-CO_2 cycle. An additional gain of 5% could be realized if blade cooling in the helium turbine could be eliminated, resulting in a total efficiency of 49.7%. The considerable temperature difference of heat removal from the carbon dioxide (from 107 to 27°C) enables a reduction in the flowrate of cooling water by a factor of seven as compared with the K-500-240 steam installation. (auth)

6709 METHOD FOR THE CALCULATION OF THE GASEOUS COUNTERFLOW REGENERATOR FOR CHEMICALLY REACTING COOLANTS. Nesterenko, V. B.; Tverkovkin, B. E.; Kovalev, S. D. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 45-53(1974). (In Russian)

The method of calculation of gas counterflow single-pass heat exchanger with chemically reacting coolant $N_2O_4 \rightleftharpoons 2NO_2 \rightleftharpoons 2NO + O_2$ is suggested here, the reaction $2NO_2 \rightleftharpoons 2NO + O_2$ being assumed nonequilibrium. The scheme of calculation of heat exchanger included iteration evaluation of flow parameters and the wall temperature with iterations on the heat flux is outlined. The results of heat computations are suggested. 15 references. (auth)

6710 ADVANCED NUCLEAR REACTORS. Trauger, D. B. (Holifield National Lab., Oak Ridge, TN). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 22-23(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 6710.

6711 (AECL-4922) ORGANIC COOLANT SUMMARY REPORT. Smee, J. L.; Puttagunta, V. R.; Robertson, R. F. S.; Hatcher, S. R. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Aug 1975. 136p. Dep. NTIS (US Sales Only) $7.00. AECL $2.50.

The development of the use of organic liquids, specifically the terphenyls, as heat transfer mediums in nuclear reactors is summarized. All phases of the development program are covered, including the choice of coolant, decomposition, coolant reprocessing, physical properties, fouling, heat transfer, and corrosion. Few experimental results are given, but rather the emphasis is on summarizing the "state of the art" as it exists within AECL at the end of 1973. (auth)

6712 EVALUATION OF ATUCHA FUEL ELEMENTS PERFORMANCE. Cirimello, R.; Sametband, M. J.; Araoz, C.; Iglesias, F.; Pinamonti, M. (Technoatom, Madrid). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 40-42(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Power Reactors, Breeding

Refer also to abstracts 5561, 5662, 6710, 6757, 6761, 6771, 6804, 6809, 6815, 6825, 6826, 6838, 6850, and 6877.

6713 (AEEW-R-987) COMPARISON OF TEMPERATURE DISTRIBUTIONS CALCULATED BY THE SABRE PROGRAMME WITH EXPERIMENTAL RESULTS. Herbert, R.; Kirsch, D. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1975. 45p. (KFK-2205). Dep. NTIS (US Sales Only) $5.00.

A joint effort has been undertaken by AEE Winfrith and GfK/IRE Karlsruhe to compare temperature distributions in the wake downstream of a blockage in rod bundles. Such temperature distributions on one hand have been measured in Karlsruhe and on the other hand can be calculated using the SABRE code developed for Winfrith under a contract placed at Imperial College, London. A brief description of the experiments and of the SABRE code are given as well as detailed measurement and calculation results. It is concluded that this code is already a very useful tool for safety investigations for LMFBRs, despite the fact that some parameters used are not very well known and that improvements to the code may be necessary. (17 references) (auth)

6714 (AERE-R-8134) CORRELATION BETWEEN FUEL PINS IRRADIATED IN FAST AND THERMAL FLUXES USING THE FRUMP FUEL PIN MODELLING PROGRAM. Hayns, M. R.; Adam, J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1975. 12p. Dep. NTIS (US Sales Only) $4.50. UK £1.00.

The differences between the behaviour of fuel pins irradiated in a thermal flux and a fast flux are analyzed. This is done by taking a typical set of conditions from an overpower experiment in a thermal flux and analysing the behaviour of the system using the fuel modelling program FRUMP. A second numerical experiment is then performed in which precisely the same conditions prevail, with the difference that a fast flux is assumed, the criterion for comparison being that the total power input to the system is the same in both cases. (auth)

6715 (AI-ERDA-13153) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS, Annual Technical Progress Report, Government Fiscal Year 1975. (Atomics International Div., Canoga Park, Calif. (USA)). 1975. Contract AT(04-3)-824. 47p. AT.

Progress is reported in the following areas: (1) irradiation damage studies in cladding and core structural materials, (2) helium generation studies in reactor materials, and (3) control absorber heating experiments and calculations. (JWR)

6716 (ANL-75-16) FLOW-INDUCED VIBRATION IN LMFBR STEAM GENERATORS: A STATE-OF-THE-ART REVIEW. Shin, Y. S.; Wambsganss, M. W. (Argonne National Lab., Ill. (USA)). May 1975. Contract W-31-109-Eng-38. 89p. Dep.. NTIS $5.45.

This state-of-the-art review identifies and discusses existing methods of flow-induced vibration analysis applicable to steam generators, their limitations, and base-technology needs. Also included are discussions of five different LMFBR steam-generator configurations and important design considerations, failure experiences, possible flow-induced excitation mechanisms, vibration testing, and available methods of vibration analysis. The objectives are to aid LMFBR steam-generator designers in making the best possible evaluation of potential vibration in steam-generator internals, and to provide the basis for development of design guidelines to avoid detrimental flow-induced vibration. (auth)

6717 (ANL-75-53) CHEMICAL INTERACTION BETWEEN FUEL AND CLADDING IN STAINLESS STEEL-CLAD FAST REACTOR FUELS. Fee, D. C.; Johnson, I.; Johnson, C. E. (Argonne National Lab., Ill. (USA)). Oct 1975. Contract W-31-109-Eng-38. 46p. AT.

The nature of the chemical interaction between mixed oxide fuel and the cladding of fast reactor fuel pins is reviewed. The irradiation of a fuel pin is discussed in terms of four processes. Processes that occur early in the life of the fuel pin are the development of a temperature gradient and the restructuring of the fuel. Processes that occur later in the life of the fuel pin are the buildup of fission products, which affects the oxygen potential, and the migration of fission products. The chemistry of corrosive attack processes is discussed in terms of both in-pile and out-of-pile observations. Current models of cladding attack are evaluated. The elimination of cladding attack through the use of getters to control the oxygen potential is discussed. (auth)

6718 (ANL-CT-76-18) INVESTIGATION OF LMFBR OUTLET PLENUM THERMAL-HYDRAULIC BEHAVIOR DURING REACTOR SCRAM TRANSIENTS. Lorenz, J. J.; Carlson, R. D.; Howard, P. A. (Argonne National Lab., Ill. (USA)). Sep 1975. 118p. AT.

An experimental and analytical investigation was conducted to study mixing in LMFBR outlet plenums. Tests were performed with water and sodium using 1/15-scale models of CRBRP and FFTF upper plenums. Froude number (ratio of buoyant to inertial forces) similitude was satisfied in order to properly establish the density differences which lead to outlet plenum flow stratification. It was found that during all normal scram runs the lower velocity, denser fluid had insufficient inertia upon entering the plenum to overcome the negatively buoyant forces and stratification ensued. Instead of penetrating well into the plenum and mixing with the fluid therein, the incoming jet was deflected downward and outward toward the exit nozzles in a mushroom-shaped stratified flow pattern. But despite dramatic flow stratification, exit nozzle transients were relatively modest for all geometries except CRBRP without chimneys. For CRBRP it was shown that the inlet chimney structure significantly mitigates flow stratification and improves plenum mixing. In constant flow runs, the torroidal flow pattern was maintained and 100 percent mixing was experienced for both sodium and water. By comparing 1/15-scale ANL and 0.55-scale B-CL water data for FFTF geometry it was found that plenum scale size is not extremely important. Fluid property effects were assessed by comparing 1/15-scale ANL sodium and water data. For both FFTF and CRBRP geometry it was shown that water and sodium transients were in fairly good agreement; thus water can be used to adequately simulate sodium. In view of these observations it was concluded that for the purpose of obtaining engineering design data relating to LMFBR outlet plenums, small scale water tests can be used to simulate full scale sodium behavior. (auth)

6719 (ANL-CT-76-19) STABILITY OF CAVITATION BUBBLES AND CAVITATION INCEPTION IN WATER AND IN LIQUID SODIUM. Cha, Y. S. (Argonne National Lab., Ill. (USA)). Oct 1975. Contract W-31-109-Eng-38. 40p. AT.

Cavitation inception is studied from the point of view of the stability of cavitation bubbles. A potential energy is defined and shown to be identical to the Helmholtz free energy of a thermodynamic system. The equation of motion of the boundary of a cavitation bubble is derived by employing the Lagrangian formulation. The stability criteria of a cavitation bubble is shown to be similar to that of the theory of small oscillations in classical mechanics, i.e., the bubble is in a state of stable equilibrium if the potential energy is a local minimum and the bubble is in a state of unstable equilibrium if the potential energy is a local maximum. The stability characteristics of a gas bubble are found to be quite different from those of a vapor bubble. The critical pressure of a cavitation bubble is very close to the vapor pressure of the liquid if the gas content in the bubble is relatively large and it decreases as the gas content in the bubble is decreased. The difference between cavitation inception in water and in liquid sodium is not significant provided that both liquids contain gas nuclei that are relatively large in size (with radius in the order of approximately 10^{-4} IN). For degassed liquids, the difference can be significant. (auth)

6720 (ANL-Trans-988) HYDROTECHNICAL PROBLEMS IN THE STEAM GENERATOR OF THE PHENIX REACTOR. Andro, M.; Salon, M. 1972. Translation of CONF-720648-10. 14p. Dep. NTIS $4.00.

A number of problems arose in the design of the Phenix reactor's steam generators, which were associated with the distribution and flow of sodium in the parallel-connected modules and the buffer tanks for the steam generator. Operating data obtained on the E.D.F. les Renardieres power plant sodium-heated vapor generator circuit confirmed the results of previous research and tests at the Grand Quevilly Thermal Research Centre and National Hydraulics Laboratory at Chatou. (auth)

6721 (ANL-Trans-997) DEVELOPMENT OF SOME STUDY AND CONSTRUCTION TECHNIQUES OF A SODIUM COOLED FAST REACTOR. Payan, G.; Milan, D.; Savornin, B. 1972. Translation of French report. (CONF-721062-11). 14p. Dep. NTIS $4.50.

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The present stage of certain advanced mechanical studies which were undertaken during execution of Phenix core-vessels is described, together with their scope of development: strength of materials, with a due account of creep problems; flow-induced random vibrations; and electron-beam welding of large austenitic steel sheets. (6 references) (auth)

6722 (ANL-Trans-998) SOME ASPECTS OF THE SODIUM PUMP FOR THE FUTURE FAST BREEDER REACTOR. Raczynski, W.; Cazes, M.; Refoublelet, P. 1972. Translation of French report. (CONF-721062-12). 19p. Dep. NTIS $4.50.

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The next stage of breeder reactor development will be the design and specification of a commercial power plant. As regards the components of this power plant, a change will be noted: in some cases, this change will result in a large increase in size as compared with present state. Problems encountered during preliminary studies on sodium pumps are described. (auth)

6723 (ANL-Trans-999) PROBLEMS RAISED BY THE DESIGN AND MANUFACTURE OF LOADING PLUGS FOR SODIUM COOLED FAST REACTORS. Lagrange, M.; Chevallier, R.; Perona, M. 1972. Translation of French report. (CONF-721062-10). 15p. Dep. NTIS $4.50.

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

Designing and manufacturing a loading plug (or rotating shield plug) such as that of the Phenix Reactor present various problems relating to wide number of fields. After enumeration of the functions of the Phenix loading plug, the principal options taken during the design period are analysed. The loading plug is then described. The main features of manufacture of these parts, both in the shops and on the site are recalled. (auth)

6724 (ANL-Trans-1019) STUDY OF THE UPPER SHIELDING OF THE PHENIX REACTOR: COMPARISON BETWEEN THE METHODS S/sub N/ AND MONTE-CARLO. Lanore, J. M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Jul 1975. Translation by J. Banfield of CEA-N-1351. 21p. Dep. NTIS $4.50.

The attenuation of the neutrons in the superior protection of Phenix is calculated for the solutions B_4C, dense graphite, and stainless steel with help of the Monte-Carlo POKER code. The results are compared to the preliminary calculations made with the SN NIOBE code. (auth)

6725 (BLG-503) PROSPECTIVE VIEW OF FAST REACTOR FUEL PIN DEVELOPMENTS. Van Asbroeck, P. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Jun 1975. 15p. (CONF-7410135-1). Dep. NTIS (US Sales Only) $4.00.

From specialist meeting on fuel element technology; Cadarache, France (2 Oct 1974).

A selection of the GBR pin oxide fuel element materials is made from a metallurgical standpoint, due account being taken of the possible environments, their metallurgical implications, the time at which additional data will become available and the necessary R & D work. 14 references. (auth)

6726 (CONF-750303-80) EVALUATED DECAY-SCHEME DATA FOR THE ILRR PROGRAM. Helmer, R. G.; Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). 1975. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The half-lives and gamma-ray intensities associated with radioactive decay have been evaluated for nuclides of interest to the Interlaboratory LMFBR Reaction Rate program. The results indicate that for most of the isotopes the decay parameters are known sufficiently well to meet the ILRR goals of 2½ or 5 percent accuracy in reaction rate measurements. (auth)

6727 (CONF-750411-40) SYSTEM FOR INCIDENT DETECTION AND CORE SURVEILLANCE FOR A FAST REACTOR. de Lapparent, D.; Gourdon, J.; Gouriou, A.; Jeannot, A.; Jallade, M.; Le Guillou, G.; Pages, J. P.; Paziaud, A.; Quinton, J. C.; Tigeot, Y. (CEA, 75 – Paris (France)). 1975. Translation of a French report. 26p. Dep. NTIS $4.00.

From European nuclear conference; Paris, France (21 Apr 1975).

The incident detection system of a Fast Reactor core covers three fields: (1) normal working (check on running order), (2) the incident situation (with alert and scram), and (3) the intermediate field in which the defect arises. The principal incidents threatening a core are reviewed, as are their new aspects when moving onto a large scale plant required to meet electric power mains. Lastly, the Surveillance and Protection System of the Super Phenix core is described. (auth)

6728 (CONF-750411-41) FUEL MANAGEMENT CODES FOR FAST REACTORS. Sicard, B.; Coulon, P.; Mougniot, J. C.; Gouriou, A.; Pontier, M.; Skok, J.; Carnoy, M.; Martin, J. (CEA, 75–Paris (France)). 1975. Translation of a French Report. 30p. Dep. NTIS $4.00.

From European nuclear conference; Paris, France (21 Apr 1975).

The CAPHE code is used for managing and following up fuel subassemblies in the Phenix fast neutron reactor; the principal experimental results obtained since this reactor was commissioned are analyzed with this code. They are mainly concerned with following up fuel subassembly powers and core reactivity variations observed up to the beginning of the fifth Phenix working cycle (3/75). Characteristics of Phenix irradiated fuel subassemblies calculated by the CAPHE code are detailed as at April 1, 1975 (burn-up steel damage). (auth)

6729 (CONF-750804-11) PRELIMINARY THERMAL-HYDRAULIC DESIGN AND PREDICTED PERFORMANCE OF THE CLINCH RIVER BREEDER REACTOR CORE. Carelli, M. D.; Markley, R. A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. Contract AT(11-1)-2395. 18p. Dep. NTIS $4.00.

From conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

The preliminary thermofluids design of the core assemblies of the Clinch River Breeder Reactor Plant (CRBRP) is presented along with the predicted performance for various plant operating conditions. The selected radial blanket assemblies shuffling scheme and the new approach adopted for fuel and blanket assemblies orificing is discussed. Relevant thermofluids parameters (assembly flow rate and mixed mean outlet temperature, fuel rod temperatures, fission gas plenum pressure, etc.) are presented. Highlights of a detailed uncertainties study performed are summarized. This preliminary analysis has shown that the CRBRP core behavior is compatible with design limits and requirements; future developments for a final analysis are outlined. (auth)

6730 (CONF-751036-2) RESULTS FROM THE TESTING OF HIGH TEMPERATURE NEUTRON DETECTORS IN A LIQUID METAL FAST BREEDER REACTOR AT TEMPERATURES UP TO 1000°F (538°C). Yingling, G. E.; Popper, G. F. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 9p. Dep. NTIS $4.50.

From international standards association conference; Milwaukee, Wisconsin, USA (6 Oct 1975).

A summary is presented of results from the performance testing of two high temperature neutron fission counter-cable assemblies and a high temperature gamma compensated ionization chamber-cable assembly in a typical Liquid Metal Fast Breeder Reactor (LMFBR) nuclear environment at temperatures up to 1000°F (538°C). A brief description of the test program, instruments and facilities is also included. (auth)

6731 (CONF-751106-5) CESIUM VAPOR CYCLE FOR AN ADVANCED LMFBR. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 29p. Dep. NTIS $5.00.

From annual meeting of ASME; Houston, Texas, USA (30 Nov 1975).

A review indicates that a cesium vapor topping cycle appears attractive for use in the intermediate fluid circuit of an advanced LMFBR designed for a reactor outlet temperature of 1250°F or more and would have the following advantages: (1) it would increase the thermal efficiency by about 5 to 10 points (from approximately 40 percent to approximately 45 to 50 percent) thus reducing the amount of waste heat rejected to the environment by 15 to 30 percent, (2) the higher thermal efficiency should reduce the overall capital cost of the reactor plant in dollars per kilowatt, (3) the cesium can be distilled out of the intermediate fluid circuit to leave it bone-dry, thus greatly reducing the time and cost of maintenance work (particularly for the steam generator), (4) the large volume and low pressure of the cesium vapor region in the cesium condenser-steam generator greatly reduces the magnitude of pressure fluctuations that might occur in the event of a leak in a steam generator tube, and the characteristics inherent in a condenser make it easy to design for rapid concentration of any noncondensibles that may form as a consequence of a steam leak into the cesium region so that a steam leak can be detected easily in the very early stages of its development. (auth)

6732 (COO-2245-21TR) DEVELOPMENT OF INPUT DATA TO ENERGY CODE FOR ANALYSIS OF REACTOR FUEL BUNDLES. Carre, F. O.; Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). May 1975. Contract AT(11-1)-2245. 182p. Dep. NTIS $7.60.

The ENERGY 1 code is a semi-empirical method for predicting temperature distributions in wire wrapped rod bundles of a LMFBR. A comparison of ENERGY 1 and MISTRAL 2 is presented. The predictions of ENERGY 1 for special sets of data taken under geometric conditions at the limits of the code are analyzed. 14 references. (auth)

6733 (EURFNR-1229) FAST BREEDER PROJECT. Third Quarterly Report, 1974. Hueper, R. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany)). Nov 1974. Translation of KFK-1274/3. 178p. Dep. NTIS $7.60.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Information is presented concerning the development and irradiation testing of PuO_2-UO_2 fuel pins; physical radiation effects on mechanical properties of austenitic steels; corrosive effects of liquid sodium on austenitic steels; analysis of nuclear data; fast reactor safety; thermocouple development; studies on sodium oxide aerosols and radionuclides; sodium technology; and thermodynamic and hydrodynamic tests in gas. (DCC)

6734 (GEAP-14045-2) RELIABILITY PROGRAM FOR SHUTDOWN HEAT REMOVAL. Second Quarterly Report, March-May 1975. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). 1975. Contract AT(04-3)-893. 50p. AT.

The objective of the LMFBR Shutdown Heat Removal (SHR) Reliability Program is to assess analytically and empirically the reliability of heat removal systems to remove heat from the reactor after scram or normal shutdown and to provide technology for assuring that reliability objectives are achieved. The reliability engineering tasks that this program encompasses can be categorized into four general groups (1) reliability analysis methods, goals, applications and criteria, (2) reliability assessments and related analyses, (3) SHR data collection and processing activities, and (4) reliability test program activities. LMFBR SHR reliability activities for the period beginning in March 1975 and ending in May 1975 are reported. Activities covered include completion of the Preliminary Reliability Report for LMFBR Heat Removal Systems, completion of the reliability program plan, and preparation of revisions to the LMFBR reliability manual. (auth)

6735 (GEAP-14051) GRO-II: A SIMPLIFIED METHOD FOR PREDICTING MIXED OXIDE FUEL ROD PERFORMANCE DURING NORMAL OPERATION. Patel, M.; White, D. E. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1975. Contract AT(04-3)-893. 58p. AT.

GRO-II is a simplified one-dimensional structural analysis code which predicts the performance of mixed oxide fuel rods with primary emphasis on the cladding. The code computes the stresses, strains and cumulative thermal creep damage in the cladding using a simplified model of the fuel-cladding mechanical interaction and the stored fission gas pressure. The cladding is modeled as a thin-walled tube and the fuel is modeled as a ring with its inner radius determined by the inviscid temperature. The input procedures and the program logic permit the analysis of operation both in the steady state and during power and temperature changes. The analytical basis, the program capabilities, the program construction and the results of preliminary calibration of the code to experimental data are presented. 8 references. (auth)

6736 (HEDL-SA-985) EFFECT OF OXYGEN IN SODIUM UPON RADIONUCLIDE RELEASE FROM AUSTENITIC STAINLESS STEEL. Brehm, W. F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1975. 30p. (CONF-750972-2). Dep. NTIS $4.50.

From IAEA specialists meeting on fission and corrosion products in primary systems of LMFBR's; Dimitrovgrad, USSR (8 Sep 1975).

A major purpose of the Radioactivity Control Technology program is to determine the effect of oxygen in sodium upon release of ^{54}Mn, ^{60}Co, and ^{58}Co from irradiated 316 stainless steel, and the distribution of the deposited nuclides in the test system. Determining the effect of oxygen in sodium upon nuclide release will define purification system equipment and operational requirements for FFTF/CRBR and future LMFBR's. A reduction in nuclide release is necessary to lower gamma dose rates in equipment cells during maintenance and repair operations, which in turn will decrease downtime and maximize plant use factor and reduce doubling time. The work was conducted in Source Term Control Loop No. 1 (STCL-1) with a specimen temperature of 604°C (1120°F), a loop minimum temperature of 427°C (800°F), sodium velocity at the specimens of 6.7 to 7.6 m/s (22 to 25 ft/sec), and oxygen levels of 0.5 +- 0.1 ppm and 2.5 +- 0.1 ppm. A reduction of greater than a factor of two in specimen weight loss was observed upon operation of the test system at 0.5 rather than 2.5 ppm oxygen. The corrosion of iron from the specimens was reduced by greater than a factor of five. The release of ^{54}Mn was reduced by about 30 percent at the lower oxygen level, while the release of $^{60}Co^{+}$ has an apparent reduction of greater than a factor of three, but with considerable scatter in the data. Reductions of this magnitude are insufficient to completely solve the nuclide release and deposition problem, but sufficient to recommend operation of LMFBR facilities at as low an oxygen level as possible

(certainly less than 1 ppm and less than 0.5 ppm if possible). (auth)

6737 (HEDL-TME-75-3) HEDL QUARTERLY TECHNICAL REPORT, JANUARY, FEBRUARY, MARCH 1975. Atwood, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. vp. AT.

Progress is reported in the following areas: sodium systems development, radioactive corrosion products, fuel failure monitoring, and development of sodium characterization systems. (JWR)

6738 (JAPFNR-195) PROGRESS REPORT ON FAST BREEDER REACTOR DEVELOPMENT AT PNC, JAPAN, APRIL–JUNE 1974. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Oct 1974. 10p. (N–251-74-25). Dep. NTIS (US Sales Only) $4.50.

Work performed under United States–Japanese Fast Reactor Exchange Program.

Progress is reported in the following areas: JOYO construction; MONJU design; reactor physics research; components development; instrumentation and control development; sodium technology; fuel and materials research; safety research; and steam generator testing. (JWR)

6739 (KFK-1275/1) FAST BREEDER PROJECT. First Quarterly Report, 1975. Hueper, R. (comp.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). Jul 1975. 178p. (In German). (EUR–5202d). Dep. NTIS (US Sales Only) $8.50.

Work performed in the first quarter of 1975 at Gesellschaft fuer Kernforschung mbH, Karlsruhe, within the framework of the Fast Breeder Project (PSB) is reported. The work covered fuel pin development, materials studies, corrosion studies, reactor physics, safety, and instrumentation. (JWR)

6740 (ORNL-tr-4033) HIGH-TEMPERATURE UNSTABILIZED AUSTENITIC STEEL X6CrNi1811 FOR SODIUM-COOLED REACTOR VESSELS, SUBMERGED ARC WELDING. Wallner, F.; Herberg, G. 1974. Translation by E. G. Silver of German report. (CONF-741094-31). 38p. Dep. NTIS $5.00.

From international colloquium on welding in nuclear engineering; Duesseldorf, F. R. Germany (23 Oct 1974).

The high operating temperatures of fast sodium-cooled breeder reactors (FBR's) require the use of high-temperature resistant austenitic steels for the fabrication of the reactor tank and the reactor interior. Certain investigations on submerged arc welding which have made it possible to apply this method in practical situations are reviewed. (auth)

6741 (R/M/N-775) SODIUM PURITY CONTROL IN CFR'S: MECHANISMS AND RATES OF CRYSTAL NUCLEATION AND GROWTH. Hebditch, D. J.; Haigh, C. P.; Gliddon, B. J. (Central Electricity Generating Board, Southampton (UK). Marchwood Engineering Labs.). Nov 1974. 37p. Dep. NTIS (US Sales Only) $5.00.

The possible crystal nucleation and growth processes occurring during precipitation from sodium are reviewed, the expressions for evaluating film diffusion mass transfer coefficients are summarised and the few published experimental investigations which gave adequate information are re-analysed using a diffusional growth controlled model for sodium oxide removal. Serious gaps in the knowledge of nucleation and growth mechanisms in sodium are revealed. This basic information is required to establish the chemical engineering principles necessary for predicting the performance encountered in reactor operation. (auth)

6742 (RT/ING–(75)8) CREEP IN PIPES: THEORETICAL CALCULATIONS AND APPLICATION TO THE PRIMARY CIRCUIT OF THE PEC REACTOR. Cesari, F.; Calcedonio Cappello, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). May 1975. 327p. (In Italian) Dep. NTIS (US Sales Only) $11.00.

Creep and stress relaxation in the hot leg of PEC reactor are analytically examined, considering also the effects of varying loads and thermal transients. The creep phenomena are of the time-hardening type, so that the strain rate is a function only of the actual stress and the current time. A qualitative approach is attempted to describe the history of a part, when subjected to real cycles of loads/temperatures. Although in cases of rapidly varying or abrupt cyclic stresses the use of a time-hardening expression may lead to nearly absurd results, discussion on the better agreement with experiments of time or stress hardening laws is not presented. (auth)

6743 (TRG-Report-2690(D)) DIGITAL REAL-TIME REACTIVITY METER FOR PFR. McWilliam, D. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). Aug 1975. 45p. Dep. NTIS (US Sales Only) $5.00. UK pounds 1.50.

A digital reactivity meter has been produced which is believed to constitute a significant advance over others reported in the literature. The main advantage of this sytem is its versatility which is brought about by the high degree of interactive operator control which is provided. The reactivity and power are continuously displayed in both graphical and α-numeric form on a TV-type of display unit. Data output is by means of an incremental graph plotter, a typewriter, or a high speed paper tape punch. The system has been extensively tested on the Prototype Fast Reactor at Dounreay and is now the standard reactivity measuring method for reactor experiments there. (auth)

6744 EXPERIMENTAL STUDY OF LOW PRANDTL NUMBER NATURAL CONVECTION IN AN ARRAY OF UNIFORMLY HEATED VERTICAL CYLINDERS. Dutton, J. C.; Welty, J. R. (Oregon State Univ., Corvallis). J. Heat Transfer; 97: No. 3, 372-377(Aug 1975).

An experimental program was conducted to study natural convection heat transfer in an array of uniformly heated vertical cylinders in mercury. The cylinders were arranged in an equilateral triangular pattern, and three bundle spacings, P/D equals 1.5, 1.3, and 1.1, were studied. The heat transfer results are presented as local Nusselt number–modified Grashof number correlations. The results indicate a strong dependence on cylinder spacing and the somewhat lesser effects of heat flux and circumferential position. In addition, mean radial temperature profiles were recorded for various conditions as well as the fluctuations in the fluid temperatures which were encountered. The influence of cylinder spacing and axial, radial, and circumferential position on these profiles and disturbances is discussed. (auth)

6745 DECREASE OF THE CONSUMPTION OF NATURAL URANIUM DURING USE OF GAS-COOLED N_2O_4 FAST REACTORS FOR THE DEVELOPMENT OF NUCLEAR POWER. Nesterenko, I. E. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 24-26(1974). (In Russian)

The results of calculations are given for natural uranium consumption as the ways to develop atomic power industry on the basis of an APS with thermal and fast reactors on N_2O_4. If to the end of the first decade the capacity of APS with thermal reactors is 30000 MW (e), and the future increase in capacity up to 300000 to 400000 MW (e) is effected at the expense of APS with fast reactors, the natural uranium consumption will be 100000 to 135000 MW (e), 50 to 70% of natural uranium being used for thermal reactors. In addition, it is shown what capacity can be developed by APS with fast reactors on N_2O_4 operating in conditions of breeders and fast reactors on U^{235} with the consumption of natural of natural uranium limited by 25000 to 50000 t. It is found that APS with fast reactors and maximum low gas temperatures, in 20 years, can develop capacity to 130000 MW (e) with the consumption of 25000 t natural uranium. 11 references. (auth)

6746 ELECTRIC UTILITY VIEW OF THE LIQUID METAL FAST BREEDER REACTOR. Behnke, W. B. (Commonwealth Edison Co., Chicago). pp 56-59 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A summary of the electric utility view of the LMFBR and the Clinch River Breeder Reactor project is presented. (JWR)

6747 ROLE AND OBJECTIVES OF THE CLINCH RIVER BREEDER REACTOR PLANT. Van Nort, P. S. (Project Management Corp., Chicago). pp 60-61 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The objectives of the CRBRP project are discussed and the status of the project is reviewed. (JWR)

6748 COMMERCIALIZATION OF THE BREEDER. Richards, R. B.; Horst, K. M.; Gibson, A. S.; Palmer, R. S. (General Electric Co., Sunnyvale, CA). pp 62-69 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

Topics discussed include: the economic and environmental incentives for the breeder; the time urgency for introduction of the breeder as a commercial energy source; and the development steps leading to commercialization of the breeder. (JWR)

6749 DEVELOPMENT AND TESTING REQUIREMENTS FOR MAJOR LMFBR COMPONENTS. Iacobellis, S. F. (Atomics International Div., Canoga Park, CA). pp 70-77 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A review is presented on the development status of major LMFBR components, the technical uncertainties in individual areas, and the capabilities of the major component testing facilities. (JWR)

6750 FRENCH LMFBR PROGRAMS. pp 78-81 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The French LMFBR program is traced from the RAPSODIE experimental reactor through the PHENIX and SUPER PHENIX projects. (JWR)

6751 UF_6 BREEDER: A SOLUTION TO THE PROBLEMS OF NUCLEAR POWER. Williams, J. R.; Clement, J. D.; Rust, J. A. (Georgia Inst. of Tech., Atlanta). pp 308-313 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812--.

Rapidly rising costs, adverse legislation, mounting public opposition and lack of a fuel reprocessing facility have resulted in over a hundred postponements and cancellations of power reactor orders during the past year and threatened the very existence of the nuclear industry. Serious consideration is now being given to a national moratorium because of the five fundamental problems of todays nuclear power reactors: cost, fuel reprocessing, safety, safeguards and radwaste. Careful consideration of viable fission-reactor alternatives which greatly reduce or eliminate these barriers to the public acceptance and widespread use of nuclear energy, is needed. Circulating-fuel breeder reactors with continuous fission-product removal and simplified on-site reprocessing have a potential for generating cheaper power and greatly reducing the safety and safeguards problems associated with fuel transportation. In addition, uranium hexafluoride gas fueled breeder reactors may "burn up" most, or possibly all, of their long-lived radioactive waste products. Because of the highly favorable economics, greatly simplified on-site fuel processing, enhanced safety (no fuel melt-down possible), and considerably reduced safeguards and radwaste problems, the uranium-hexafluoride breeder reactor may well be the solution to the problems facing the nuclear industry. Analytical studies for ^{233}U-F_6 fueled breeder reactors have predicted breeding ratios in the range of 1.2 to 1.3, fuel doubling times of a few years or less, and power plant efficiencies in the range of 35 percent to 50 percent. (auth)

6752 CONCEPTUAL DESIGN OF A FLUIDIZED BED STEAM GENERATOR FOR THE LMFBR. Kearns, D. L. (Westinghouse Research Labs., Pittsburgh); Newby, R. A.; Cooper, M. H.; Adkins, C. R.; Bieberbach, G. pp 338-341 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A fluidized bed steam generation system, FBSG, is being developed for the liquid metal fast breeder reactor, LMFBR. The FBSG eliminates the need for an intermediate sodium loop and heat exchanger utilized in the current design and isolates the sodium and water thus reducing the possibility of a sodium-water reaction. A conceptual design for a stacked sodium and water tube bundle fluidized bed steam generator is presented and the circulating fluidizing gas system is described. An experimental program is underway to develop design data and demonstrate concept feasibility. Results of initial tests are used to establish the conceptual design. The development program is discussed and objectives outlined. (auth)

6753 COMPARISON AND EVALUATION OF NUCLEAR POWER PLANT OPTIONS FOR GEOSYNCHRONOUS POWER STATIONS. Williams, J. R. (Georgia Inst. of Tech., Atlanta). pp 1264-1274 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

A solution to the safety, safeguards, and radwaste disposal problems of nuclear power is to locate the breeder reactor power plants far out in geosynchronous orbit and beam the power to earth with microwaves. The generation of nuclear power in space is technologically feasible and has already been demonstrated on a small scale. It has also been shown that high efficiency microwave transmission of power from synchronous orbit to earth is feasible and is not hazardous. The reactor safety problem would be virtually eliminated because of the remoteness of the satellite power station in geosynchronous orbit. The worst possible accident at such a plant would have negligible effect on the earth, certainly less than the high altitude nuclear explosions which have been conducted in the past. Accidental re-entry from geosynchronous orbit could not occur because of the very large velocity change required. The safeguards problem can be virtually eliminated by adopting the following procedures: 1) The plant is initially started up using U-235 fuel or bred plutonium or U-233 from another geosynchronous power plant, 2) Once the plant is operating, only nonhazardous fertile materials (thorium or depleted uranium) are shipped up from earth, 3) The fissile fuel is bred and used in space, and none of this highly toxic fissile material is ever returned to earth. The radioactive waste could be concentrated and ejected in canisters into deep space away from the earth. The geosynchronous nuclear power plant offers unlimited nuclear power without nuclear hazards or nuclear pollution, but at somewhat higher cost. Whether or not society will be willing to pay these higher costs of nuclear power from space, or whether new energy resources such as nuclear fusion or solar power become feasible, remains to be seen. A prudent course to follow would be to give careful consideration to all future options for large scale energy generation, including the option of nuclear power from space. (auth)

6754 PRESENT CONDITION OF THE FAST BREEDER REACTORS IN FRANCE. Vendryes, G. (Commissariat a l'Energie Atomique, Paris). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 23-24(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

Research, Test, and Experimental Reactors

Refer also to abstracts 6718, 6737, 6806, 6817, 6818, 6855, 6861, and 6877.

6755 (CEA-R-4667) ANALYSIS OF TIME OF FLIGHT TECHNIQUES APPLIED TO NEUTRON SPECTRA MEASUREMENTS IN FAST SUBCRITICAL ASSEMBLIES. Rotival, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13—Saint-Paul-les-Durance (France). Service des Experiences Critiques et de Physique des Reacteurs). Apr 1975. 285p. (In French) Dep. NTIS (US Sales Only) $10.25.

Thesis. Submitted to Univ. of Lyon.

Time-of-flight measurements on Uranium-Graphite assemblies were performed using the BCMN linear accelerator. This report describes the methods to provide scalar spectra averaged over a core cell from these experimental results. (auth)

6756 (CONF-750431-3) VARIABLE RELUCTANCE DISPLACEMENT TRANSDUCER TEMPERATURE COMPENSATED TO 650°F. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1975. 13p. Dep. NTIS $4.50.

From 8th transducer workshop; Dayton, Ohio, USA (21 Apr 1975).

In pressurized water reactor tests, compact instruments for accurate measurement of small displacements in a 650°F environment are often required. In the case of blowdown tests such as the Loss of Fluid Test (LOFT) or Semiscale computer code development tests, not only is the initial environment water at 650°F and 2200 psi but it undergoes a severe transient due to depressurization. Since the LOFT and Semiscale tests are run just for the purpose of obtaining data during the depressurization, instruments used to obtain the data must not give false outputs induced by the change in environment. A LOFT rho v^2 probe and a Semiscale drag disk are described. Each utilizes a variable reluctance transducer (VRT) for indication of the drag-disk location and a torsion bar for drag-disk restoring force. The VRT, in addition to being thermally gain and null offset stable, is fabricated from materials known to be resistant to large nuclear radiation levels and has successfully passed a fast neutron radiation test of 2.7×10^{17} nvt without failure. (auth)

6757 (CONF-750469-1) COMPONENT DESIGN FOR LMFBR's. Fillnow, R. H.; France, L. L.; Zerinvary, M. C.; Fox, R. O. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. 17p. Dep. NTIS $4.00.

From annual American power conference; Chicago, Illinois, USA (21 Apr 1975).

Just as FFTF has prototype components to confirm their design, FFTF is serving as a prototype for the design of the commercial LMFBR's. Design and manufacture of critical components for the FFTF system have been accomplished primarily using vendors with little or no previous experience in supplying components for high temperature sodium systems. The exposure of these suppliers, and through them a multitude of subcontractors, to the requirements of this program has been a necessary and significant step in preparing American industry for the task of supplying the large mechanical components required for commercial LMFBR's. (auth)

6758 (CONF-750607-34) FABRICATION OF INTERNALLY INSTRUMENTED REACTOR FUEL RODS. Schmutz, J. D.; Meservey, R. H. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. 10p. Dep. NTIS $4.50.

From American Nuclear Society Meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Procedures are outlined for fabricating internally instrumented reactor fuel rods while maintaining the original quality assurance level of the rods. Instrumented fuel rods described contain fuel centerline thermocouples, ultrasonic thermometers, and pressure tubes for internal rod gas pressure measurements. Descriptions of the thermocouples and ultrasonic thermometers are also contained. (auth)

6759 (CONF-750698-1) INELASTIC ANALYSIS OF EBR II: IHX SECONDARY OUTLET NOZZLE. Ahmed, H.; Stone, C. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 29p. Dep. NTIS $4.50.

From United States/Japanese specialists meeting; Washington, District of Columbia, USA (19 Jun 1975).

Thermal stress analysis for the EBR-2 reactor intermediate heat exchanger is presented. The sodium inlet and outlet temperatures are determined from a reactor thermal analysis. The effects of thermal transients on the structural integrity of the heat exchanger are evaluated. Inelastic strain evaluation and creep-fatigue evaluation are described. 14 references. (DCC)

6760 (CONF-750935-3) FAST NEUTRON SPECTRUM AND DOSIMETRY STUDIES IN THE COUPLED FAST REACTIVITY MEASUREMENTS FACILITY. Rogers, J. W.; Harker, Y. D.; Millsap, D. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). 1975. 20p. Dep. NTIS $4.50.

From 1st ASTM-Euratom symposium on reactor dosimetry; developments and standardization; Petten, Netherlands (22 Sep 1975).

The fast neutron spectrum of the Coupled Fast Reactivity Measurements Facility (CFRMF) at the Idaho National Engineering Laboratory (INEL) is being used to study and standardize fast reactor neutron dosimetry materials and methods. The CFRMF has been designated a "benchmark experiment" to test the cross section data of dosimetry materials as well as other materials used and produced in fast reactors. Information about the neutron energy spectrum of the CFRMF is presented. (auth)

6761 (CONF-750966-3) LMFBR SAFETY TESTING NEEDS AND THE CONCEPTUAL DESIGN OF A NEW SAFETY RESEARCH EXPERIMENT FACILITY. Marchaterre, J. F.; Matlock, R. G.; Goldman, A. J. (Argonne National Lab., Ill. (USA)). Sep 1975. Contract W-31-109-Eng-38. 20p. Dep. NTIS $4.00.

From international conference on extreme load conditions and limit analysis procedures for structural reactor safeguards and containment structures; West Berlin, F.R. Germany (8 Sep 1975).

Experiment needs for the LMFBR safety program are reviewed. The screening of reactor concepts which would meet the needs is described and a conceptual design for a new safety research experiment facility is presented. (JWR)

6762 (CONF-751012--10) BRAZED THERMOCOUPLE PASS-THROUGH FOR SODIUM SERVICE IN A LIQUID-METAL-COOLED FAST BREEDER REACTOR. Walker, D. E. (Argonne National Lab., Ill. (USA)). Oct 1975. Contract W-31-109-Eng-38. 14p. Dep. NTIS $4.50.

From SME/ERDA welding and joining workshop; Chicago, Illinois, USA (28 Oct 1975).

Sensors installed in special fuel elements for the EBR-II reactor had 30-ft-long leads that would pass from the sodium environment through a sealed bulkhead. A hydrogen-atmosphere, induction-heated brazing furnace was constructed to simultaneously braze 20-26 separate sensor leads at one time. The brazed seals were leak-tight, and the sheath wall has less than 10 percent interaction with the braze alloy. (auth)

6763 (CONF-751101--18) POWER BURST FACILITY: POWER OSCILLATION PROBLEM. Lussie, W. G.; Wadkins, R. P.; Wells, R. A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. 7p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

In late 1973 PBF achieved a power level of 15 MW. During this period of operation fluctuations in reactor power were observed. Many possible causes of these fluctuations were considered and a number of nuclear and non-nuclear tests were conducted. Initial instrumentation installed in the core showed coolant outlet temperature variations of 10^0F for several fuel cannisters and approximately 10 percent power variations at 15 MW. Power spectral density analysis showed a predominant frequency of 0.05 to 0.06 HZ. The testing program to determine the cause of the power oscillations is described. (auth)

6764 (CONF-751101--31) SUBCRITICALITY CALCULATIONS FOR THE FFTF REVERSE APPROACH TO CRITICAL EXPERIMENT. Selby, D. L.; Flanagan, G. F. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 5p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

The reverse approach to critical (RAC) experiments were performed in the ZPR-IX critical facility at Argonne National Laboratory. One of the major objectives of this project is to determine the adequacy of the low-level flux monitor (LLFM) detectors for initial loading of the Fast Flux Test Facility (FFTF). 5 references. (auth)

6765 (DP-REPORT-794) ROLE OF IRRADIATION EXPERIMENTS IN THE DEVELOPMENT OF HIGH TEMPERATURE REACTORS. Dragon Project. Barr, P.; Everett, M. R.; Graham, L. W. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). May 1972. 42p. (CONF-7205115-1). Dep. NTIS (US Sales Only) $5.25.

From symposium on the future of neutron irradiation facilities in Europe; Petten, Netherlands (16 May 1972).

During the 12 years of its existence, the OECD High Temperature Reactor Project, Dragon, has had a unique opportunity of using a wide range of irradiation facilities throughout Europe. These were initially employed to ensure the success of the core design, the construction and the operation of the Dragon High Temperature Reactor Experiment itself, and later played a key role in the development of core materials for high temperature power reactors. The various phases in the work are identified, and the types of experiments associated with them are outlined. The importance of the contribution of the MTR support teams in the overall success of the programme is stressed. (48 references) (auth)

6766 (HEDL-SA-979) FULL SCALE WITHDRAWAL TESTING OF FFTF/LMFBR FUEL ASSEMBLIES. Richman, R. B.; Fiskum, O. S.; LeGore, T. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract E(45-1)-2170. (CONF-751101-46). Dep. NTIS $5.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Withdrawal characteristics of five major designs of fuel assembly nozzle were evaluated. Results of these tests contributed to development of the final FTR core design, comprising a nozzle with a single upper piston ring and a lower close-clearance region in an Inconel 718 receptacle liner. Testing in both the sodium environment and in air verified the choice of a chromium-plated fuel assembly nozzle to provide superior resistance to nozzle wear, and to preclude any damage to the long-life liner. (auth)

6767 (HEDL-TME-75-97) FTR HCM SCALE-MODEL SHAKER TEST. Ryan, J. A.; Simmons, M. D.; White, R. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1975. 44p. AT.

Characteristic response frequencies, mode shapes and damping values were experimentally determined on head-hung components in the Hydraulic Core Mockup (HCM), a quarter scale FTR model. Tests were performed in-situ, with and without water in the vessel. Test results have been used to determine the virtual mass effects of the water/structure interface, to evaluate HCM modelling accuracy, and to assist in the interpretation of flow-induced vibration data. (auth)

6768 (JUL-1215) ZERO ENERGY EXPERIMENT KAHTER FOR THE HIGH TEMPERATURE REACTOR CONSTRUCTION AND EXPERIMENTAL RESULTS OF PHASE I WITH HOMOGENEOUS PEBBLE BED. Krings, F. J.; Drueke, V.; Jonas, H.; Kirch, N.; Neef, R. D.; Rueckert, M. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jul 1975. 86p. (In German). Dep. NTIS (US Sales Only) $6.00.

The critical pebble bed experiment KAHTER and the aim of

the experiment are described. The experiments of phase I and their results are discussed. For the comparison with calculations, critical masses, reactivity worths of absorber rods and reaction rates are measured. The influence of backscattering from the walls and a change of the filling factor of the pebble bed on the critical mass are investigated. Reactivity-worths of absorbers are determined by means of the inhour-method, the subcritical multiplication, the pulsed source measurements and the inverskinetic method. These methods are compared one with another. Here special attention is payed to the dependence of the detector position. Reaction rates are measured in the thermal, epithermal, and fast energy region. (auth)

6769 (LMEC-75-11) FFTF PUMP SEAL TEST FINAL REPORT. Hall, J. (Atomics International, Canoga Park, Calif. (USA). Liquid Metal Engineering Center). 15 Sep 1975. Contract E(04-3)-700. 210p. AT.

A series of checkout and performance tests of the FFTF prototype pump seals was conducted at the LMEC to determine the suitability of candidate seal designs for application to the FFTF pump. The test program included pre-test inspections, checkout testing, performance testing, and post-test inspections and measurement of seal wear. Life testing of the seals was originally planned but was later deleted from the program. Seal testing included performance at two levels of pressure: primary pump conditions at 10 psig nominal, and secondary pump conditions at 160 psig nominal pressure. The test program confirmed that the basic seal design was satisfactory. Testing of an alternate design was included, although testing of the prototype design occupied most of the program. Results obtained in this test program revealed the need for certain modifications to the prototype pump. Most of these were incorporated in the final configuration of the pump. A significant result of checkout testing revealed the need for hydrostatic lift-off capability in the Kingsbury thrust bearing. (auth)

6770 (ORNL-TM-4939) TEMPERATURE DISTRIBUTION IN A 19-ROD SIMULATED LMFBR FUEL ASSEMBLY IN A SCALLOPED DUCT (FUEL FAILURE MOCKUP BUNDLE 1B)-RECORD OF EXPERIMENTAL DATA. Fontana, M. H.; Gnadt, P. A.; Kress, T. S.; MacPherson, R. E.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 178p. AT.

Experimental data obtained from Fuel Failure Mockup bundle 1B, which simulated the configuration and power level of a segment of a Fast Test Reactor fuel subassembly, is presented. Bundle 1B consisted of 19 electric cartridge heaters with outside diameters of 0.230 in. spaced by 0.056-in. wire wraps on a 12-in. pitch and enclosed in a scalloped duct. The purpose of this test series was to obtain thermal-hydraulic data for use in design of the Fast Test Reactor core. The report includes a description of the system and the experimental procedures, a discussion of the data reduction procedures, and tabulated data from the experiments performed in this series. (auth)

6771 (ORNL-TM-4996) DESCRIPTION OF FTR DESIGN-ORIENTED IRRADIATION TEST OF Eu_2O_3 IN EBR-II. Martin, M. M.; Pasto, A. E.; Woods, J. W.; Donnelly, R. G. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 64p. AT.

The experiment described in this document is designed to investigate the performance of cubic and monoclinic europia in a fast-reactor environment. As an advanced absorber material, Eu_2O_3 offers the possibility of a reliable, long-lived, environmentally acceptable, and economical control system. A distinct advantage is the absence of both helium and tritium generation in reactor. The general objective of this test is to qualify the irradiation behavior of Eu_2O_3 to reduce design uncertainties and permit its serious consideration for use in fast reactors. The description covers in detail the experimental objectives, design, thermal analysis, fabrication, characterization of test specimens and flux monitors, irradiation testing, and postirradiation examination plans. The experiment involves 223 Eu_2O_3 pellets in 23 pins inside 11 capsules. Irradiation will be conducted in three subassemblies designated by the EBR-II Project as X205, X205A, and X245. (auth)

6772 METHOD FOR THE DETERMINATION OF β_{eff} IN SYSTEMS WITH SPONTANEOUS NEUTRON FISSION. Sapozhnikov, V. V.; Lukhanin, A. P. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 40-41(1974). (In Russian)

A method for determination of Beff is proposed based on the knowledge of the rate of spontaneous fission and total number of fission events of the assembly. (auth)

6773 TEMPERATURE CONTROL WITH HIGH PERFORMANCE GRAVITY-ASSIST HEAT PIPES. Kemme, J. E.; Deverall, J. E.; Keddy, E. S.; Phillips, J. R.; Ranken, W. A. (Los Alamos Scientific Lab., NM). pp 1502-1506 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).

From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.

The development of high performance heat pipes for controlling the temperature of irradiation experiments in the Experimental Breeder Reactor (EBR-II) is described. Because this application involves vertical operation in a gravity-assist mode with the evaporator down, several tests were made with sodium and potassium heat pipes in this position to establish their performance limits as a function of operating temperature. Best performance was achieved with a new wick structure consisting of a fine porous liner next to the heat-pipe wall and four helical channels next to the vapor passage. (13 references) (auth)

6774 FLUIDELASTIC TUBE VIBRATION IN A HEAT EXCHANGER DESIGNED FOR SODIUM-TO-AIR OPERATION. Halle, H.; Boers, B. L.; Wambsganss, M. W. (Argonne National Lab., Argonne, Il.). J. Eng. Power; 97: No. 4, 561-568(Oct 1975).

Analysis and testing were performed to evaluate the potential for flow induced vibrations of the finned U-tubes of a sodium-to-air dump heat exchanger of the Fast Flux Test Facility (FFTF). The analysis showed that fluidelastic vibration of the U-bend sections, caused by a displacement-dependent mechanism, could be experienced. Consequently, model tests, with prototypic tubing and stagnant water simulating the sodium mass on the tubeside, were performed. The tests consisted of subjecting the overhanging U-bends of a bank of five U-tubes to a range of air flow velocities at room temperature. Test results showed that, for a given support and restraint condition, a critical flow velocity exists above which large vibration amplitudes are induced. Characterization of the critical flow velocity was investigated. Supplementary single tube experiments determined vortex shedding frequencies, U-tube natural frequencies, damping, and, separately, the effect of internal water flow. (auth)

6775 DESIGN OF A CRITICAL ASSEMBLY FACILITY FOR RESEARCH AND PERSONNEL TRAINING IN REACTOR PHYSICS. Hukai, R. Y.; Granziera, M. R.; Ting Kao Sun, D.; Holland, L.; Ferreira, A. C. A.; Baltazar, O.; dos Reis Filho, P. E. G.; Peluso, M. A. V.; Nakata, H.; Matsuda, K. (Instituto de Energia Atomica, Sao Paulo, Brazil). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 11(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6776 REACTOR USE IN NUCLEAR ENGINEERING PROGRAMS. Murray, R. L. (North Carolina State Univ., Raleigh). Nucl. Technol.; 27: No. 1, 15-17(Sep 1975).

Nuclear reactors for dual use in training and research were established at about 50 universities in the period since 1950, with assistance by the U. S. Atomic Energy Commission and the National Science Foundation. Most of the reactors are in active use for a variety of educational functions, laboratory teaching of undergraduates and graduate students, graduate research, orientation of visitors, and nuclear power plant reactor operator training, along with service to the technical community. As expected, the higher power reactors enjoy a larger average weekly use. Among special programs are reactor sharing and high-school teachers' workshops. (auth)

Production and Materials Testing and Processing Reactors

6777 (HW-80692) THERMAL AND HYDRAULIC CHARACTERISTICS OF AN N-REACTOR FUEL COLUMN. Anderson, J. K.; Batch, J. M.; Thorne, W. L.; Fitzsimmons, D. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 24 Jun 1964. 70p. Dep. NTIS $6.00.

Declassified 17 December 1973.

Laboratory experiments were conducted to determine flow-pressure-drop relationships in an N-reactor fuel column under a variety of flow conditions with various steam-water mixtures. These experiments were conducted with a full-scale electrically heated model of the downstream half of an N-Reactor fuel column which included a dummy (spacer) charge and outlet connector fittings. Results of the experiments can be used to determine thermal and hydraulic responses of the reactor cooling system to a variety of abnormal conditions, and to set operating limits which will assure a reactor shutdown under such conditions. Experiments were performed at pressures of 300, 850, 1200 and 1400 psig, but emphasis was placed on those at 1200 and 300 psig. The 1200-psig experiments were chosen to provide a

conservative representation of normal full-power operating conditions and the 300-psig experiments approximate the start-up and emergency coolant supply pressure. The data were analyzed and results presented in several ways which are convenient for application to N-Reactor. Summaries of each of these follow. (auth)

6778 (ORNL-TM-5025) SEAL MODIFICATION FOR A V-BAND. Abbatiello, A. A. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

An aluminum gasket with a small volume added at one point has been developed and is recommended for sealing a leak in the HFIR HB-1 beam-tube flange. This type of gasket, in a symmetrical form, was originally tested and proposed in February, 1972. It has now been revised to fit a specific eroded area found when the HFIR was disassembled for a scheduled major overhaul, after ten years of operation. The modified gasket consists of a ring made of 0.093-in.-diam wire with the normal contour increased to $\frac{1}{8}$ in.^{2} in the section at the cavity region and oriented to place this section over the eroded area. Special tools and viewers are available for checking its position. (auth)

6779 (UNI-436) ISOTOPIC COMPOSITION OF IRRADIATED MARK IV AND MARK IA FUEL. McNeece, J. P. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 29 Sep 1975. Contract AT(45-1)-1857. 60p. Dep. NTIS $5.50.

Fission product inventories were calculated with the computer code RIBD. Input physics and engineering parameters for RIBD and fissionable nuclide inventories were calculated with DCODE. Isotopic composition for both Mark IA and Mark IV fuel was calculated for exposures from 500 MWD/T to 5000 MWD/T in increments of 500 MWD/T and for cooling times out to 10 years. 10 references. (auth)

Propulsion and Package Reactors

Refer also to abstracts 6672 and 6823.

6780 (AE-61-0045) VEHICLE STUDIES IN SUPPORT OF NERVA NUCLEAR ROCKET ENGINE. (General Dynamics/Convair, San Diego, Calif. (USA)). 24 Feb 1961. 72p. Dep. NTIS $5.50.

Declassified 2 Oct 1975.

A number of studies were conducted to define the Nerva nuclear rocket engine design features and operational characteristics which are determined by the vehicle design considerations. The design features considered included: (1) the basic engine cycle, (2) vehicle flight control, (3) tank pressurization, (4) nozzle design, (5) pump design, and (6) shielding. The engine installation design and procedure was investigated, considering the over-all vehicle requirements. The engine duty cycle, vibration environment, telemetry interface, and reliability requirements were also studied. Several engine design parameters which are determined by the vehicle were established and are presented. It was determined that the hot-gas-bleed cycle is the most suitable basic cycle for the Nerva engine. For vehicle flight control, engine gimbaling capability should be provided. Roll control can be most effectively provided by hinging the turbopump exhaust nozzle. The engine should be capable of supplying bleed gas for pressurization of the tank during propellant expulsion. An engine source for the initial pressurization upon restart would also be desirable. An over-all safety analysis reveals that the nuclear hazards are somewhat less than the potential hazards due to the toxicity of beryllium. Several aspects of desirable engine operational characteristics are discussed. For some missions, the Nerva engine will have to have the capability of as many as four firings. The anticipated engine vibration environment is given. The potential mission capabilities of the Nerva engine incorporated in an upper stage of the Saturn D vehicle were investigated. An over-all plan for integration of the nuclear rocket engine in the vehicle was developed and is presented. A number of specific recommendations on the engine development, generated as the result of these studies, are listed. (auth)

6781 (AGC-1955) MONTHLY PROGRESS REPORT NO. 3 FOR OCTOBER 1961. (Bendix Corp., Southfield, Mich. (USA). Research Labs. Div.). 1961. 10p. Dep. NTIS $4.50.

Declassified 23 Sep 1975.

Preliminary conceptual design layouts for three actuators so that the various electropneumatic servo control actuation subsystems may be integrated into the engine system are nearing completion. The designs are based upon use of a proportional area control valve supplying a gear motor. A gear motor has been firmly chosen as the power element by consideration of the relatively low working pressures and the moderately high loads. Various transmission modes have been considered based on reduction ratio and load requirements, relative inertia, size, weight, and desirable actuator configuration. Preliminary designs have been made showing several mounting and transmission approaches. Final selection of the transmission will be made following the design review meeting. Principal action items unresolved center around definition of system failure modes (need for locking devices, time delay circuits, etc.), actual loads against which the actuators must function, and mission profile information. Parts for the actuation subsystem are available and construction of the system and of facilities for testing it in a simulated environment is underway. Preliminary design studies of high temperature, radiation-tolerant pressure transducers for integration into the engine control system have been made. Initial recommendations have been made with respect to the establishment and methods of attainment of reliability and quality assurance goals in the development of the NERVA nuclear rocket engine. (LTN)

6782 (L-0560-10-2) INFORMAL MONTHLY PROGRESS LETTER NO. 2 TO AEC-NASA NUCLEAR PROPULSION OFFICE FOR PROJECT NERVA COVERING PERIOD 1 AUGUST-31 AUGUST 1961. (Aerojet-General Corp., Azusa, Calif. (USA)). 1961. 29p. Dep. NTIS $5.00.

Declassified 23 Sep 1975.

Progress in preliminary reactor and engine design is reported. Special study has been given to thermal and fluid flow, radiation heating, neutron activation, control systems analysis, and preliminary mechanical and nuclear design calculations. Coordination with other groups is outlined. Engine simulator studies, controls research and development, safety, reliability, nozzle studies, remote handling equipment, radiation effects and component testing are considered briefly. (LTN)

6783 (L-0560-10-21) INFORMAL MONTHLY PROGRESS LETTER NO. 21 TO AEC-NASA SPACE NUCLEAR PROPULSION OFFICE COVERING PERIOD OF MARCH 1963. NERVA Program. (Aerojet-General Corp., Azusa, Calif. (USA)). 1963. 198p. Dep. NTIS $8.50.

Declassified 29 Sep 1975.

Work involved mainly the NRX-AI and KIWI reactors, especially with respect to turbopumps and their bearings, fuel elements, pressure vessels, actuators, reactor instrumentation and nozzles. Difficulties in casting aluminum nozzle jackets are reported and efforts to correct the problem are discussed. Facilities are being prepared for testing reactors and critical components. Work on fragmenting reactors in space is summarized. (LTN)

6784 (LAMS-2648) INTERACTION OF LIQUID HYDROGEN WITH THE KIWI-B REACTOR. Stiles, C. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 19 Jan 1962. Contract W-7405-Eng. 36. 61p. Dep. NTIS $5.50.

Declassified 28 Aug 1973.

To obtain a better understanding of the interactions of core parameters when transient variations of hydrogen reactivity are introduced into the reactor, analog computer studies were made of the core dynamics using a model of the Kiwi-B reactor. Ten sets of data are presented and discussed in a qualitative fashion. The variation in the core parameters of most interest are presented for the following examples: varying the hydrogen flow rate while holding the control rods fixed, varying reactor power while holding the hydrogen flow rate constant and simultaneous variations in both reactor power and hydrogen flow rate. The trends and variations in hydrogen flow rate, reactor power, outlet gas temperature, control rod reactivity, hydrogen reactivity and core temperature reactivity are discussed for each of the three conditions outlined. (auth)

6785 (N-75-17606) TURBULENCE COEFFICIENTS AND STABILITY STUDIES FOR THE COAXIAL FLOW OR DISSIMILAR FLUIDS. Final Report, June 1964-August 1974. Weinstein, H.; Lavan, Z. (Illinois Inst. of Tech., Chicago (USA)). Feb 1975. 232p. (NASA-CR-142198). NTIS $7.50.

Two analytical investigations of fluid dynamics problems of relevance to the gaseous core nuclear reactor program are presented. The investigations were separately abstracted and indexed for NSA. (DG)

6786 (N-75-17607) INVESTIGATION A: NUMERICAL SOLUTIONS OF DRIVEN VORTICES OF BINARY FLUID IN A CYLINDRICAL GEOMETRY. Shin, Y. W.; Lavana, Z. (Illinois Inst. of Tech., Chicago (USA)). Feb 1975. 146p. (N-75-17606). NTIS.

In turbulence coefficients and stability studies for the coaxial flow or dissimilar fluids. Final Report.

The steady state laminar motion of a viscous, incompressible and binary fluid is studied for a rotating flow in a cylindrical geometry. The mathematical model employed is a cold flow

simulation of the fluid mechanics of the light-bulb concept of the gaseous core nuclear engine. A numerical treatment is developed for the rotating flow which includes a description of the nuclear fuel addition. The problem is formulated with the complete Navier-Stokes equations in order to show the interaction between the fuel addition, the main flow, and the boundary layer flow in an accurate manner. The results presented show holdup of the nuclear fuel for the case of steady fuel addition. (auth)

6787 (N-75-17608) INVESTIGATION B: LAMINAR CONFINED COAXIAL ENTRANCE FLOW WITH HEAT GENERATION. Bobba, G. K. M.; Weinstein, H. (Illinois Inst. of Tech., Chicago (USA)). Feb 1975. 76p. (N-75-17606). NTIS.

In turbulence coefficients and stability studies for the coaxial flow or dissimilar fluids. Final Report.

The results of a parametric study on the entrance flow region in a gas core nuclear reactor are presented. The physical system is modeled as laminar confined, coaxial flow with heat generation in the inner fluid. The governing equations include the boundary layer approximations and the assumptions of only radial radiative transport of energy represented as an energy diffusion term. The Von Mises transformation and a zeta transformation are used to transform the equations into nonlinear nonhomogeneous convective-diffusion equations. A unique combination of forward and backward difference equations which yields accurate results at moderate computational times, is used in the numerical method. Results show that the rapidly accelerating, heat generating inner stream actually shrinks in radius as it expands axially. (auth)

6788 (N-75-18402) MATERIALS TECHNOLOGY FOR AN ADVANCED SPACE POWER NUCLEAR REACTOR CONCEPT: PROGRAM SUMMARY. Gluyas, R. E.; Watson, G. K. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1975. 57p. (NASA-TN-D-7909; E-7893). NTIS $4.25.

The results of a materials technology program for a long-life (50,000 hr), high-temperature (950 C coolant outlet), lithium-cooled, nuclear space power reactor concept are reviewed and discussed. Fabrication methods and compatibility and property data were developed for candidate materials for fuel pins and, to a lesser extent, for potential control systems, reflectors, reactor vessel and piping, and other reactor structural materials. The effects of selected materials variables on fuel pin irradiation performance were determined. The most promising materials for fuel pins were found to be 85 percent dense uranium mononitride (UN) fuel clad with tungsten-lined T-111 (Ta-8W-2Hf). (auth)

6789 (NTO-R-0041) ETS-1 PROCESS WATER SYSTEM TEST PROGRAM REPORT. Christenson, J. F.; Henze, H. (Aerojet-General Corp., Jackass Flats, Nev. (USA)). 11 Aug 1965. 148p. Dep. NTIS $7.00.

Severe oscillations in the water system supplying water to the ETS-1 NERVA Exhaust Duct were finally attributed to cavitation at the duct simulation orifice and the 20 inch flow control valve. A recommendation was made to replace the duct simulation orifice with a flow constriction tube to simulate the exhaust duct pressure drop without inducing cavitation or excessive fluid turbulence. A number of other recommendations were made with the aim of preventing vibrations in the system and minimizing the transmission of system disturbances. (LTN)

6790 (NTO-R-0045) NRX-A3 POST TEST REPORT. Supplement. (Aerojet-General Corp., Jackass Flats, Nev. (USA)). 30 Sep 1965. 63p. Dep. NTIS $5.50.

Declassified 18 Sep 1975.

Post test metallography of NRX-A3 fuel elements and certain other components was carried out in hot cells at LASL. (LTN)

6791 (NTO-R-0141(Vol. 1)) NRX-A6 POST TEST REPORT. Volume 1. Disassembly. (Aerojet-General Corp., Jackass Flats, Nev. (USA)). [nd]. 80p. Dep. NTIS $6.00.

Declassified 5 Sep 1973.

The NRX-A6 post test disassembly operations have been completed; post operative examinations are still in progress. The results noted during disassembly have confirmed the ability of the NRX-A6 Test Assembly to operate at design conditions for a period of 60 minutes. The condition of the fuel was generally excellent. There was very little corrosion in evidence. The NbC bores were generally intact. Some corrosion occurred on the peripheral elements located adjacent to thin filler strips. The uncoated fuel elements were bonded together at the midsection and had to be separated mechanically. A "cluster buster" was designed to break apart the bonded elements. This device operated satisfactorily and held total element breakage down to less than 20%. The integrity of the bond between the element keys and the elements had been lost prior to disassembly. The reflector evidenced a large number of cracks, with the center ring appearing to have the most occurrences. All other components were basically intact. (auth)

6792 (NTO-R-0166(Suppl. 1)) SPEAR REPORT. Drum and Shield Worth, Thermal Calibration, and Dosimetry Irradiation. (Aerojet-General Corp., Jackass Flats, Nev. (USA)). [nd]. 16p. Dep. NTIS $4.50.

Declassified 18 Sep 1975.

The thermal calibration test of the XE-PRIME reactor was completed successfully and all objectives were met. Qualitative comparison of core stations 0.5 and 1.0 temperature measurements with pre-test predictions shows reasonable agreement. A quantitative comparison of the data with post-test computer calculations will be made at WANL. Measured control drum bank rotation during the thermal calibration test will also be used at WANL to determine a temperature reactivity coefficient. The nuclear subsystem was maintained within acceptable limits during the thermal calibration. A few instrumental anomalies are noted. After the thermal calibration test, the engine was cooled with GN_2. The GN_2 flow was not held constant long enough for the engine to reach thermal equilibrium. Therefore, the thermal power will be in error by the reactor sensible heat transferred to or from the coolant. Rough estimates of the sensible heat varied from 10% to -45%. This uncertainty is too large to accurately calculate the thermal power from the GN_2 cooling portion of the dosimetry irradiation test. (auth)

6793 (RN-NTO-HB-0002) NTO HEALTH AND SAFETY CRITICALITY CONTROL MANUAL. Haertjens, B. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1964. 52p. Dep. NTIS $5.50.

Declassified 30 Sep 1975.

NERVA Test Operations at NRDS involve the handling, transporting, and storing of various amounts of fissionable material. It is essential that all possible measures be taken to prevent an accidental assembly or accumulation of a critical mass. Criticality control is based on the adequate control of those parameters and criteria which govern the critical conditions of an assembly or accumulation of fissionable material. This manual establishes the basic rules, guides, and limits for the handling, transporting, and storage of fissionable material in any form. It is an aid to line management in fulfilling their responsibility for maintaining nuclear safety. (auth)

6794 (RN-PA-0003) TURBOPUMP STABILITY AND TEST STAND DYNAMICS. (Aerojet-General Corp., Azusa, Calif. (USA)). 15 Jun 1964. 81p. Dep. NTIS $6.00.

Declassified 12 Sep 1973.

An analysis of the turbopump and test facilities was presented to SNPO personnel and has been documented. A mathematical model of the turbopump and facility was presented. Also, stability criteria, including a necessary condition for turbopump stability, were developed. Nonlinear analysis performed on an analog computer confirmed the predictions from the analysis. (auth)

6795 (RN-S-0017) FINAL REPORT OF NUCLEAR LUNAR LOGISTICS SYSTEM STUDY. Vanica, D. F. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Nov 1963. 87p. Dep. NTIS $6.00.

Declassified 17 Sep 1975.

Preliminary results of a study performed by the REON Division of the Aerojet-General Corporation to define engine operating parameters for an operational nuclear third stage based on NERVA technology for use with the SATURN V launch vehicle are presented. The work was performed under Subcontract 74-10039 from the Lockheed Missiles and Space Company. The Mod 1 NERVA-class operational engine represents a conservative design with primary emphasis on reliability and performance secondary. Design reserves have been applied liberally so that it is possible to reduce system and component weights and still increase operating pressures and temperatures. This study has demonstrated that the present NERVA engine design is capable of being uprated without major modifications. The design level selected for the Mod 2 engine can be considered as conservative with some design reserve remaining to further increase reactor operating temperature. Availability depends on demonstration of a successful reactor test. Within the present NERVA development schedule the earliest this can happen is late 1964 with the first operational flight scheduled in early 1973. The Mod 2 engine, requiring higher temperatures, flow rates and pressure could be available for the first development flight test in early 1974. Cost for the development of the Mod 1 engine is estimated to be one billion dollars through qualification. An additional 52 million dollars is required to develop the Mod 2 engine. Since the components and systems are common to both mods, the unit cost is estimated to be the same. (auth)

6796 (RN-S-0110) MARK III TURBOPUMP ASSEMBLY PERFORMANCE TEST RESULTS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1964. 84p. Dep. NTIS $6.00.
Declassified 11 Nov 1975.
The performance of the NERVA turbopump assembly is presented with particular emphasis on test results obtained with the Mark III Mod 3 configuration. The tests involved determining LH_2 pumping performance at various conditions and shaft speeds. Problems in the evaluation of pumping performance with LH_2 are discussed. (auth)

6797 (RN-S-0232(Rev.)) NRX/EST TEST PREDICTION REPORT. Revision 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Nov 1965. 105p. Dep. NTIS $6.50.
Declassified 8 Oct 1975.
The NRX/EST test will be the first test of a complete engine system in the NERVA program. The tests are designed to demonstrate the feasibility of the hot-bleed cycle, nuclear-engine system to accomplish bootstrap startup into the power region and operate at full power. In preparation for these tests, a detailed analysis of the system has been performed with the results recorded in this Test Prediction Report. The objectives are: to ensure that the tests as planned can be accomplished in a safe manner, to provide means of quickly evaluating test data during the various test phases, to ensure that emergency safety measures are adequate if required, and to provide a means of evaluation of the analytical programs. The test article will use the NRX-A4 reactor, a Mark III Mod 4 turbopump, a U-tube nozzle with a bypass hot bleed port and a counter-current heat exchanger. The engine will be fired nozzle up using a modified NRX test car. The steady-state operating region is mapped in order to show the proposed power holds that are planned during the test series and identify the safe operating limits. The constraints are mapped as functions of chamber pressure and temperature—the primary system control variables. Transient analyses of the system have been made on each phase of the test. (auth)

6798 (RN-S-0281) NERVA MATERIAL DEVELOPMENTS. First Quarter, Contract Year 1966. Progress Report, 1 October–31 December 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1966. 83p. Dep. NTIS $6.00.
Declassified 22 Sep 1975.
Activities of the NERVA Program in the field of materials and process during the First Quarter of SNP-1 Contract Year 1966 are discussed. Topics include materials investigations relative to: nozzle, turbopump, bearings, pressure vessel, facilities, radiation effects, design specifications and properties. (auth)

6799 WORLD'S NUCLEAR POWERED SHIPS. Chung, W. H. J. Korean Nucl. Soc.; 7: No. 1, 53-68(Mar 1975). (In Korean).
The world's nuclear powered ships are reviewed, mainly based on the development of the marine nuclear reactor and the present trends of nuclear warships and merchant ships in the world. Emphasis is on the four nonmilitary nuclear ships: the Russian ice breaker Lenin, the American cargo-passenger ship Savannah, the German ore carrier Otto Hahn, and the Japanese cargo ship Mutsu. The nuclear fleets in U. S., U. K., USSR, and France are described in view of historical development and the present stock of the nuclear ships. Present projects and future trends for nuclear merchant ships in the main shipbuilding countries are also discussed. (17 figures) (auth)

6800 LIGHTWEIGHT NUCLEAR POWERPLANT APPLICATIONS OF A VERY HIGH TEMPERATURE REACTOR (VHTR). Thompson, R. E. (Westinghouse Electric Corp., Pittsburgh). pp 1089-1097 of Tenth Intersociety Energy Conversion Engineering Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1975).
From 10th intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975). See CONF-750812-.
Feasibility studies on the use of very high temperature reactors for propulsion applications are summarized. The applications include ships, air cushion vehicles, hydrofoils, and surface effect ships. The reactor design is based to a great deal on NERVA technology. (JWR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 5555, 5572, 5583, 5584, 5592, 5601, and 5959.

6801 (ANCR-1233) EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TEST S-02-3 (BLOWDOWN HEAT TRANSFER TEST). Crapo, H. S.; Jensen, M. F.; Sackett, K. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Sep 1975. Contract E(10-1)-1375. 93p. Dep. NTIS $5.45.
Recorded test data are presented for Test S-02-3 of the Semiscale Mod-1 blowdown heat transfer test series. Test S-02-3 was conducted from an initial cold leg fluid temperature of 544°F and an initial pressure of 2,263 psig. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with a moderately heated core (75 percent design power level). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was also set at the 75 percent design level to achieve full core temperature differential. The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.2 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling (DNB) occurs. Blowdown to the pressure suppression system was accomplished without simulated emergency core coolant injection or pressure suppression system coolant spray. (auth)

6802 (ANCR-1240) INTACT LOOP PUMP PERFORMANCE DURING THE SEMISCALE MOD-1 ISOTHERMAL TEST SERIES. Loomis, G. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Oct 1975. Contract E(10-1)-1375. 50p. Dep. NTIS $5.45.
An analysis was performed on the Semiscale Mod-1 intact loop pump data taken during the Semiscale Mod-1 isothermal test series. The pump was shown to directly affect intact loop and vessel flow rates during the early portion of the simulated loss-of-coolant accidents (LOCAs). Comparison of pump performance data taken during the Semiscale Mod-1 isothermal tests with data obtained during previous steady state and transient tests indicated that the pump head degraded more rapidly during the Semiscale Mod-1 tests. Calculations using the pump model contained in the RELAP4 computer program are compared with these pump performance data. Areas of operation for the Semiscale Mod-1 pump are defined for the transient two-phase steam-water flows that occurred during several isothermal blowdown tests, and suggested refinement in the two-phase characteristics of the Semiscale Mod-1 pump model is offered. 13 references. (auth)

6803 (ANCR-1253) EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TEST S-01-6. Crapo, H. S.; Jensen, M. F.; Sackett, K. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Sep 1975. Contract E(10-1)-1375. 92p. Dep. NTIS $5.45.
Recorded test data are presented for Test S-01-6 of the Semiscale Mod-1 isothermal blowdown test series. Test S-01-6 is one of several Semiscale Mod-1 experiments which are counterparts of the LOFT nonnuclear experiments. System hardware is representative of the LOFT design with the design based on volumetric scaling methods and with initial conditions duplicating those identified for LOFT nonnuclear tests. Test S-01-6 was conducted with an inactive 40-rod core in place of the orificed core simulator used on previous isothermal tests. The test was initiated at isothermal conditions of 2,263 psia and 541°F by a simulated offset shear of the cold leg broken loop piping. During system depressurization, coolant was injected into the cold leg of the operating loop to simulate emergency core cooling (ECC). (auth)

6804 (ANL-75-57) SUMMARY AND EVALUATION: FUEL DYNAMICS LOSS-OF-FLOW EXPERIMENTS (TESTS L2, L3, AND L4). Barts, E. W.; Deitrich, L. W.; Eberhart, J. G.; Fischer, A. K.; Meek, C. C. (Argonne National Lab., Ill. (USA)). Sep 1975. Contract W-31-109-Eng-38. 76p. Dep. NTIS $5.45.
Three similar experiments conducted to support the analyses of hypothetical LMFBR unprotected-loss-of-flow accidents are summarized and evaluated. The tests, designated L2, L3, and L4, provided experimental data against which accident-analysis codes could be compared, so as to guide further analysis and modeling of the initiating phases of the hypothetical accident. The tests were conducted using seven-pin bundles of mixed-oxide fuel pins in Mark-II flowing-sodium loops in the TREAT reactor. Test L2 used fresh fuel. Tests L3 and L4 used irradiated fuel pins having, respectively, "intermediate-power" (no central void) and "high-power" (fully developed central void) microstructure. 12 references. (auth)

6805 (ANL-75-58) LIGHT-WATER-REACTOR SAFETY RESEARCH PROGRAM: QUARTERLY PROGRESS REPORT FOR APRIL–JUNE 1975. Sachs, R. G. (Argonne National Lab., Ill. (USA)). 26 Sep 1965. Contract W-31-109-Eng-38. 83p. Dep. NTIS $5.45.
The Argonne National Laboratory work performed during April, May, and June 1975 on water-reactor-safety heat-transfer and

flow problems is reported. The following research and development areas are covered: (1) Loss-of-coolant Accident Research; Heat Transfer and Fluid Dynamics; (2) Transient Fuel Response and Fission-product Release Program; and (3) Mechanical Properties of Zircaloy Containing Oxygen. (auth)

6806 (ANL-75-61) REXCO PREDICTIONS OF ELASTIC AND ELASTOPLASTIC DEFORMATION OF FLUID-FILLED PIPES AND COMPARISONS WITH EXPERIMENTS OF 1/10 SCALE FFTF PIPE MODELS. Nagumo, G.; Fiala, C. (Argonne National Lab., Ill. (USA)). Sep 1975. Contract W-31-109-Eng-38. 44p. AT.

The reactor-containment code REXCO provides a two-dimensional capability to treat the plastic deformation of a pipe and to predict the effect of structural yield on the transmitted pressure pulse. The code is used to simulate two experiments of 1/10-scale pipe models of the FFTF primary loop where high-pressure pulses cause elastic and elastoplastic deformations of the pipe wall. Calculational and experimental results are compared to evaluate the experiments and to provide an interpretation of the data that is consistent with two-dimensional analysis. The results demonstrate the capability of the code to compute the elastic and elastoplastic deformations of pipes and to predict the hydrodynamic effect of wall deformation on the transmitted pressure pulse. The application of the code to scaled models is significant since the mathematical model of the pipe neglects the effect of strain rate and assumes a scaling factor of unity. 12 references. (auth)

6807 (ANL/RAS-75-42) CONTRIBUTION TO THE THEORY OF THE TWO PHASE BLOWDOWN PHENOMENON. Hutcherson, M. N. (Argonne National Lab., Ill. (USA)). Dec 1975. Contract W-31-109-Eng-38. 359p. Dep. NTIS $11.50.

Thesis. Submitted to Univ. of Missouri, Columbia.

In order to accurately model the two phase portion of a pressure vessel blowdown, it becomes necessary to understand the bubble growth mechanism within the vessel during the early period of the decompression, the two phase flow behavior within the vessel, and the applicability of the available two phase critical flow models to the blowdown transient. To aid in providing answers to such questions, a small scale, separate effects, isothermal blowdown experiment has been conducted in a small pressure vessel. The tests simulated a full open, double ended, guillotine break in a large diameter, short exhaust duct from the vessel. The vaporization process at the initiation of the decompression is apparently that of thermally dominated bubble growth originating from the surface cavities inside the system. Thermodynamic equilibrium of the remaining fluid within the vessel existed in the latter portion of the decompression. A nonuniform distribution of fluid quality within the vessel was also detected in this experiment. By comparison of the experimental results from this and other similar transient, two phase critical flow studies with steady state, small duct, two phase critical flow data, it is shown that transient, two phase critical flow in large ducts appears to be similar to steady state, two phase critical flow in small ducts. Analytical models have been developed to predict the blowdown characteristics of a system during subcooled decompression, the bubble growth regime of blowdown, and also in the nearly dispersed period of depressurization. This analysis indicates that the system pressure history early in the blowdown is dependent on the internal vessel surface area, the internal vessel volume, and also on the exhaust flow area from the system. This analysis also illustrates that the later period of decompression can be predicted based on thermodynamic equilibrium. (auth)

6808 (ANL-Trans-1000) FAST NEUTRON REACTOR POWER PLANT PHENIX. Megy, J.; Guillemard, B.; Robert, E.; Crette, J. P.; Labat, P. 1972. Translation of French report, (CONF-721062-9). 16p. Dep. NTIS $4.50.

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

Main features of Phenix, i.e., power integrated design, fuel and fuel handling cycles are summarized. The main difficulties met and solutions which were selected in the field of design, main component tests and manufacturing are described. (auth)

6809 (BMI-X-664) SENSITIVITY ANALYSES FOR POSTULATED LMFBR ACCIDENT CONDITIONS. Gieseke, J. A.; Reed, L. D. (Battelle Columbus Labs., Ohio (USA)). Oct 1975. Contract W-7405-eng-92. 70p. Dep. NTIS $5.45.

Predictions of released radioactivity resulting from postulated accidents in LMFBRs require that analyses of aerosol behavior be made. It is expected that many radiologically important species will be in the form of aerosol particles or adsorbed onto such particles. Materials anticipated to form aerosols are sodium oxide and fuel materials. The agglomeration growth, transport, deposition, and release from the containment of aerosols are predicted by the several available aerosol behavior models. The time-dependent size, concentration, deposition, and release of airborne particles are functions of assumed containment geometry and assumed initial aerosol properties. The computer-predicted effects of such assumed conditions on airborne aerosol mass concentration or mass leaked are discussed. Also, the effects of using different available computer codes are illustrated in terms of the details assumed for aerosol behavior mechanisms. The effects of assumed initial aerosol properties and of containment geometry serve to illustrate the importance of the various parameters thereby guiding the selection of critical experimental studies and the consideration of important containment design features. (auth)

6810 (BNWL-SA-5435) DIRECT EFFECTS OF COLD SHOCK: BIOASSAYS WITH THREE COLUMBIA RIVER ORGANISMS. Becker, C. D.; Schneider, M. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 19p. (CONF-750985-5). Dep. NTIS $4.50.

From 15th Hanford life sciences symposium; Richland, Washington, USA (25 Sep 1975).

Results of studies of the direct effects of cold shock on the pumpkinseed sunfish (representing a warmwater fish), the rainbow trout (representing a coldwater fish), and the common crayfish showed that resistance to cold shock varies between species, is dependent on acclimation temperature, and resistance to temperature declines is dependent on the decline rate. Severe cold shock at a sublethal level is accompanied by disorientation, loss of equilibrium, and immobilization. Pumpkinseed, the warm water species, are most susceptible. Rainbow, the cold water species, are less susceptible; at an acclimation 10°C, rainbow survive abrupt shock to levels slightly above freezing. Crayfish, the decapod crustacean, are most resistant; at an acclimation of 15°C, crayfish survive abrupt shock to the point just above freezing. (CH)

6811 (CENPD--56) STEAM-WATER MIXING TEST PROGRAM. Task D: Informal Report. System Design Description for Tasks A and B. Lowe, P. A. (Combustion Engineering, Inc., Windsor, Conn. (USA). Nuclear Power Dept.). Jul 1972. Contract AT(11-1)-2244. 44p. Dep. NTIS $5.00.

The test apparatus for use in the Steam-Water Mixing Test Program is described. The apparatus is to be used for investigating the interaction of emergency core cooling water with steam flow generated by the core reflood. For physical scaling purposes, a typical four-inlet loop pressurized water reactor is modeled. The program background is outlined and the objectives are presented. The design basis and the measurement systems are discussed in detail. (auth)

6812 (CONF-750360-1) ANALYSIS OF FUEL BEHAVIOR DURING REACTIVITY INITIATED ACCIDENTS. Thompson, L. B.; Tolman, E. L.; MacDonald, P. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1975. Contract AT(10-1)-1375. 23p. Dep. NTIS $4.50.

From OECD halden reactor project conference; Geilo, Norway (17 Mar 1975).

An analysis of fuel rod behavior during reactivity initiated accidents is presented. The calculational approach is described, predictions are discussed and compared to data from the SPERT power excursion tests, and the sensitivity of maximum cladding temperatures to initial reactor conditions, enthalpy insertions, and other experiment design parameters is investigated. 10 references. (auth)

6813 (CONF-750607-35) THERMAL-HYDRAULIC ANALYSIS OF THE FIRST SEMISCALE MOD-1 TEST SERIES. Mecham, D. C.; Cartmill, C. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1975. 17p. Dep. NTIS $4.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The predicted behavior of the semiscale Mod-1 system obtained through use of the RELAP4 computer program is compared with the experimentally observed response. Isothermal Test S-01-4A, chosen here as representative of the first test series, included a cold leg break configuration. The first test series was conducted under isothermal conditions. The electrically heated rods were replaced with a core simulator. (auth)

6814 (CONF-751101--15) LUMPED-PARAMETER FUEL ROD MODEL FOR RAPID THERMAL TRANSIENTS. Perkins, K. R.; Ramshaw, J. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jul 1975. Contract AT(10-1)-1375. 7p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

The thermal behavior of fuel rods during simulated accident

conditions is extremely sensitive to the heat transfer coefficient which is, in turn, very sensitive to the cladding surface temperature and the fluid conditions. The development of a semianalytical, lumped-parameter fuel rod model which is intended to provide accurate calculations, in a minimum amount of computer time, of the thermal response of fuel rods during a simulated loss-of-coolant accident is described. The results show good agreement with calculations from a comprehensive fuel-rod code (FRAP-T) currently in use at Aerojet Nuclear Company. (auth)

6815 (COO-2571-2) IMPROVEMENT AND VERIFICATION OF FAST REACTOR SAFETY ANALYSIS TECHNIQUES. Jackson, J. F. (Brigham Young Univ., Provo, Utah (USA)). 1975. Contract AT(11-1)-2571. 21p. Dep. NTIS $4.50.

An initial analysis of the KIWI-TNT experiment using the VENUS-II disassembly code has been completed. The calculated fission energy release agreed with the experimental value to within about 3 percent. An initial model for analyzing the SNAPTRAN-2 core disassembly experiment was also developed along with an appropriate equation-of-state. The first phase of the VENUS-II/PAD comparison study was completed through the issuing of a preliminary report describing the results. A new technique to calculate a P-V-work curve as a function of the degree of core expansion following a disassembly excursion has been developed. The technique provides results that are consistent with the ANL oxide-fuel equation-of-state in VENUS-II. Evaluation and check-out of this new model are currently in progress. (auth)

6816 (GEAP-13317-10) BWR BLOWDOWN HEAT TRANSFER TENTH QUARTERLY PROGRESS REPORT COVERING OCTOBER 1--DECEMBER 31, 1974. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jan 1975. Contract AT(04-3)-189. 75p. Dep. NTIS $5.50.

Blowdown Heat Transfer (BDHT) testing with the first 49-rod bundle has been completed. Data from seven BDHT tests are reported. Conclusions are drawn regarding the effects of variation of several independent parameters. The second 49-rod bundle has been installed in the Two-Loop Test Apparatus (TLTA) in preparation for the second series of BDHT tests. (15 references) (auth)

6817 (HEDL-TC-274(DR)) ANALYSES OF STEEL LINERS ON CONCRETE STRUCTURES. Polentz, L. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 149p. Dep. NTIS $7.00.

A post-accident-heat-removal structural effects analysis for the steel liner in the FFTF concrete containment structure is presented. (JWR)

6818 (HEDL-TME-75-60) POSTACCIDENT HEAT REMOVAL ASSESSMENT FOR THE FFTF. Armstrong, G. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1974. Contract AT(45-1)-2170. vp. AT.

An assessment of the potential for safely removing the residual heat generated by fission product decay after postulated hypothetical core disruptive accidents was performed using available analytical and experimental data. The resultant structural configuration, flow conditions, and core debris distribution and characteristics were the major areas addressed. The results confirm that 100 percent of the dispersed core resulting from the postulated initiating HCDA events in the FFTF can be adequately cooled and permanently retained in the reactor vessel. (auth)

6819 (INIS-mf-1702, pp 33-51) ANALYSIS OF EQUIPMENT OPERATION SAFETY AND FEASIBLE AVAILABILITY FACTORS OF NUCLEAR POWER PLANTS. Emel'yanov, I. Ya.; Baturov, B. B.; Klemin, A. I.; Strigulin, M. M.; Godreev, V. S.; Shiverskii, E. A. 1974. (In Russian).

From Jubilee conference dedicated to the twentieth anniversary of nuclear power engineering; Obninsk, USSR (25 Jun 1974).

In nuclear power plant operating experience and prospects of nuclear power engineering. Vol. 1. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow).

The need is shown for using a quantitative approach in studying the safety of operating and proposed nuclear power stations. The safety of these electrical stations and the chief elements of instrumentation of their first loop were analyzed quantitatively by treating statistically data obtained during actual use. In particular, the safety of the reactor operating channels, piping, pumps, and other equipment was studied. The quantitative indices obtained for the safety of a nuclear power station unit as a whole and of the individual units were evaluated. The individual equipment units limiting the reliability of the installation were identified, and basic means for increasing the nuclear power station reliability were noted. An evaluation was made, starting with the information obtained, of the actually achieved value of the degree of availability of nuclear power plants. (tr-auth)

6820 (KFK-2217) THEORETICAL AND EXPERIMENTAL METHODS TO DETERMINE THE PROPERTIES OF MOLTEN CORE COMPONENTS AND REACTION PRODUCTS. Nazare, S.; Ondracek, G.; Schulz, B. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Oct 1975. 56p. (In German). Dep. NTIS (US Sales Only) $5.50.

In the course of a loss of coolant accident, a sequence of events would be initiated that ultimately could lead to core melting. The course of these events and the consequences of core meltdown would in part be determined by the properties of the core materials and the products of their interaction. On the basis of available theoretical and experimental results, the estimation is presented of properties such as: work of adhesion between UO_2 – und (U, Zr) liquid phase; heat of fusion of some melts; heat capacity of liquid reaction products; viscosity of liquid reaction products; and thermal conductivity of liquid reaction products. (auth)

6821 (NEDO-13426) MARK III CONFIRMATORY TEST PROGRAM: ONE-THIRD SCALE POOL SWELL IMPACT TESTS, TEST SERIES 5805. McIntyre, T. R.; Bilanin, W. J.; Ross, M. A.; Torbeck, J. E. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Aug 1975. vp. General Electric Co., San Jose, CA.

A series of 51 blowdown tests was performed in support of the Mark III pressure suppression concept with particular emphasis on the effect of pool swell impact on structures located above the suppression pool. The integrated steam generator and drywell of the Pressure Suppression Test Facility was used to accelerate the water mass in the one-third scale suppression pool to velocities typical of Mark III containments, and the impact of this water on I-beams, pipes, and gratings was investigated. The loading mechanism was found to be high velocity pressure waves which traveled along the surface of impacted structures, with a wave velocity defined by the movement of the points of intersection between the horizontal target structures and the rising curved pool surface. The impulse associated with this loading was found to correlate as a function of pool approach velocity, target geometry, and water ligament thickness, the last variable being important only when the ligament thickness approached target dimensions. For pool surface velocities expected to occur in Mark III, the maximum measured impulses for all targets were 35 percent or less of those being used for Mark III design specifications. For targets of circular cross section, loads were one-half or less than the values for comparable flat surfaces. Both the factor of three and the pipe shape factor must be considered when evaluating the conservatism in the Mark III design specifications. (auth)

6822 (NEDO-21061) MARK II CONTAINMENT DYNAMIC FORCING FUNCTIONS: INFORMATION REPORT. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div., Sargent and Lundy, Chicago, Ill. (USA)). Sep 1975. 407p. General Electric Co., San Jose, CA.

A methodology is presented for predicting potential thermal hydraulic dynamic loading conditions in a BWR plant having a Mark II pressure suppression containment system during a loss-of-coolant accident, safety/relief valve discharge, and related dynamic events. Information and guidance has been provided to allow an evaluation of the design conditions for the various structures which form the containment design. Observed test data and analytical models upon which the loading functions are based, are discussed, explained, and justified. (auth)

6823 (NUS-145) RADIOBIOLOGICAL CONSIDERATIONS IN REENTRY OF NUCLEAR REACTOR FRAGMENTS. Topical Report. Goldman, M. I.; DeAgazio, A. W.; Garcia, L. F.; Lee, J. S. (Nuclear Utility Services, Inc., Washington, D.C. (USA)). Jul 1963. 69p. Dep. NTIS $5.50.

Declassified 28 Sep 1964.

The destruction of a nuclear stage following operation (whether normal or abnormal) will create fragments with appreciable fission product, or other radioactive, inventories which may be dispersed over great or small areas of the earth depending upon the circumstances. Aside from the problem of hazards in the area of the launch site, a major concern in the safety evaluation of nuclear rocket operations must be with the damage that could accrue from the essentially uncontrolled radiation exposures to fragments impacting on the earth's surface. In the rocket case, relatively large particles can be expected to impact almost anywhere along the trajectory band of the rocket prior to destruction; in the weapon test case, large particles settle from the cloud within a relatively short distance of the burst, and only the widely-dispersed very small particles constitute a significant "off-site" or world-wide problem. The major function of a post-operational destruct (or other safety) system employed in nuclear rocket engines must be to produce a velocity and/or size distribution of fragments which, upon returning to the earth's surface, will not cause significant injuries to persons in the vicinity of such particles. In or-

der to provide a basis for destruct system criteria, the effects accruing from exposure to single (or a few) particles has been examined. The following recommendations seem warranted: Better information is required on size distribution of reactor fragments following destruct and reentry, on the spatial and temporal distribution of such particles on the earth's surface, and on the biological effects resulting from exposure to such particles. A statement of policy with respect to "acceptable risk" from accidental exposures of this sort must evolve from the cognizant Government agencies. (auth)

6824 (ORNL-TM-4712) SIMULATION OF NUCLEAR FUEL RODS BY USING PROCESS COMPUTER-CONTROLLED POWER FOR INDIRECT ELECTRICALLY HEATED RODS. Malang, S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 63p. Dep. NTIS $5.45.

An investigation was carried out to determine how the simulation of nuclear fuel rods with indirect electrically heated rods could be improved by use of a computer to control the electrical power during a loss-of-coolant accident (LOCA). To aid in the experiment, a new version of the HETRAP code was developed which simulates a LOCA with heater rod power controlled by a computer that adjusts rod power during a blowdown to minimize the difference in heat flux of the fuel and heater rods. Results show that without computer control of heater rod power, only the part of a blowdown up to the time when the heat transfer mode changes from nucleate boiling to transition or film boiling can be simulated well and then only for short times. With computer control, the surface heat flux and temperature of an electrically heated rod can be made nearly identical to that of a reactor fuel rod with the same cooling conditions during much of the LOCA. A small process control computer can be used to achieve close simulation of a nuclear fuel rod with an indirect electrically heated rod. (auth)

6825 (ORNL-TM-4980) LMFBR SAFETY AND CORE SYSTEMS PROGRAMS. Progress Report for January–March 1975. Fontana, M. H.; Wantland, J. L. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 131p. AT.

Progress is reported for the following activities: analysis and data evaluation of flow-coastdown tests; water system mockup of the Fuel Failure Mockup (FFM); development of detection methods for flow and blockage phenomena; FFM facility operations; and LMFBR electric heater and LWR fuel pin simulator development. (JWR)

6826 (ORNL-TM-5021(Vol.3)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR APRIL–JUNE 1975. III. Liquid-Metal-Cooled Fast Breeder Reactor Safety. Fontana, M. H.; Kress, T. S. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 51p. Dep. NTIS $5.45.

Information on the LMFBR reactor safety program is presented concerning radionuclide release and transport as a result of reactor events including the hypothetical core-disruptive accident. A capacitor discharge vaporization technique is being developed for generating electrical energy directly in LMFBR fuel that will produce HCDA-like fuel disassemblies. The scoping tests for this technique are continuing with two additional sets of experiments consisting of five tests each. The results and analyses of these tests are reported. (auth)

6827 (ORNL-TM-5021(Vol.4)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR APRIL–JUNE 1975. IV. High-temperature Gas-cooled Reactor Program. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Sep 1975. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

Digital computer codes for simulating the dynamics of HTGR components and systems were developed further. Component simulations for use in the overall NSS simulation have been completed and are operational for the core, steam generator, and turbine-generator, and initial runs have been made with a coupled core-steam generator model. Component models were also completed for the Core Auxiliary Heat Exchanger (CAHE) and Core Auxiliary Cooling Tower (CACT). Work continued on implementing the RECA code on the ORNL IBM 360 computers. (6 references) (auth)

6828 (ORNL-TM-5126) APPLICATION OF ALAP CONCEPT TO EXPOSURE OF WORKERS AT LIGHT-WATER REACTORS. Dickson, H. W.; Cottrell, W. D.; Jacobs, D. G. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 48p. Dep. NTIS $5.45.

The application of the as-low-as-practicable (ALAP) philosophy to radiation exposure of workers at light-water reactors (LWR's) has recently received increased attention. The purpose of this project is to investigate the means by which occupational exposure at operating LWR's can be reduced to the lowest practicable levels. Nine such LWR stations, including 16 operating reactors, have been studied in phase I of the project to identify significant sources of exposure and to determine the magnitude of the exposures. A complete site review consists of compiling information from safety analysis reports (SAR's), plant technical specifications, and radiation exposure records and then making an on-site visit for discussions with plant personnel, observation of procedures, and measurement of radiation levels. In phase II, specific problem areas are being studied in-depth with regard to corrective measures to reduce exposure. Information has been collected on solving the problem of exposure from valve maintenance and repair. These corrective measures will be evaluated with respect to ease of application and cost effectiveness. The results of this study will serve as technical backup for the preparation of regulatory guides. (auth)

6829 (ORNL-TM-5178) MONTHLY HIGHLIGHTS FOR OFFICE OF NUCLEAR REGULATORY RESEARCH PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (Comp.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 27p. Dep. NTIS $4.00.

6830 (SAND--75-5987) HOW SHOULD A LOSS OF COOLANT ACCIDENT BE STUDIED. Steck, G. P. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 9p. (CONF-751113--1). Dep. NTIS $4.50.

From first ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

The development of a Monte Carlo model to analyze water-cooled reactor LOCA conditions is described. (DCC)

6831 (UCRL-77371) SITE RESPONSE CALCULATIONS FOR NUCLEAR POWER PLANTS. Wight, L. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1975. Contract W-7405-Eng-48. 24p. (CONF-751204-1). Dep. NTIS $4.25.

From ASCE specialty conference; New Orleans, Louisiana, USA (8 Dec 1975).

Six typical sites consisting of three soil profiles with average shear wave velocities of 800, 1800, and 5000 ft/sec as well as two soil depths of 200 and 400 ft were considered. Seismic input to these sites was a synthetic accelerogram applied at the surface and corresponding to a statistically representative response spectrum. The response of each of these six sites to this input was calculated with the SHAKE program. The results of these calculations are presented. (auth)

6832 (UEC-TR-002-0) CHARACTERISTICS OF TORNADO GENERATED MISSILES. Bhattacharyya, A. K.; Boritz, R. C.; Niyogi, P. K. (United Engineers and Constructors, Inc., Philadelphia, Pa. (USA)). Oct 1975. 129p. United Engineers and Constructors Inc., Philadelphia.

The development of techniques designed to calculate tornado missile velocities is traced. It is shown that there is a need for a consistent method for obtaining missile velocities for a variety of tornado parameters. A consistent method for determination of trajectories and velocities of missiles generated by a tornado is described. The effects of plant layout upon missile impact velocity at a given building are discussed from the point of view of determining the necessary missile barrier characteristics. 19 references. (auth)

6833 (WCAP-7918(Rev.2)) DESCRIPTION OF THE BLODWN-2 COMPUTER CODE. Fabic, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Oct 1970. vp. Westinghouse Electric Corp., Pittsburgh.

Documentation of the Westinghouse Proprietary, BLODWN-2 Code is presented. The mathematical models and assumptions on which the Code is based and the methods employed to arrive at their numerical solutions are described. The INPUT preparation, OUTPUT options, and a sample problem are also given. The program is written in FORTRAN-4 language and runs on the CDC-7600 digital computer. (auth)

6834 (XN-75-41(Suppl. 6)) EXXON NUCLEAR COMPANY WREM-BASED GENERIC PWR ECCS EVALUATION MODEL. Supplement 6. Supplementary Information Relating to Reflood and Heatup Analysis. (Exxon Nuclear Co., Richland, Wash. (USA)). 27 Oct 1975. 42p. Exxon Nuclear Co. Inc., Richland, WA.

Supplement 6 is divided into three principal sections, one responding to questions regarding reflood analysis, another presenting the results of a sensitivity study determining the effect of exposure on peak cladding temperatures, and the third detailing and justifying the RELAP4 model proposed for calculating ECC

injection rates from end-of-bypass (EOBY) to bottom-of-core-recovery (BOCREC). (auth)

6835 (XN--75-41(Vol.2)(App.D)) WREM-BASED GENERIC PWR ECCS EVALUATION MODEL. 3-Loop Westinghouse Large Break Example Problem (Using September 26, 1975 Model). (Exxon Nuclear Co., Richland, Wash. (USA)). 2 Oct 1975. 145p. Exxon Nuclear Co., Inc., Richland, WA.

Appendix D is presented as a demonstration of the WREM/ENC calculational procedure using a typical Westinghouse three-loop NSSS. The calculational procedures used are in accordance with the ENC PWR evaluation model as described in XN-75-41, volumes I and II and supplements, including Supplement 5, Revision 1 (the September 26, 1975, model). The loss-of-coolant accident investigated was a double-ended guillotine cold leg break. Three analyses are presented which include discharge coefficients (C/sub D/) of 1.0, 0.6 and 0.4. The investigation involved calculations using the following primary WREM/ENC codes: RELAP4-EM for blowdown and hot channel analysis, TOODEE2 for hot channel during refill and reflood, and RELAP4-EM FLOOD for core reflood analysis. This appendix includes descriptions of all portions of the loss-of-coolant analysis with example problem input. Principal results of these analyses are contained in Tables. These results include peak clad temperatures and metal/water reaction percentages. Also included are summaries of the transient time sequences for major events. All salient results from the three analyses are presented in graphical form. (auth)

6836 EFFECT OF PRECURSORY COOLING ON FALLING-FILM REWETTING. Sun, K. H. (American Society of Mechanical Engineers, New York); Dix, G. E.; Tien, C. L. J. Heat Transfer; 97: No. 3, 360-365(Aug 1975).

From winter annual meeting of American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

An analytical model for falling-film wetting of a hot surface has been developed to account for the effect of cooling by droplet-vapor mixture in the region immediately ahead of the wet front. The effect of precursory cooling is characterized by a heat transfer coefficient decaying exponentially from the wet front. Based on the present model, the wet front velocity, as well as the temperature profile along a thin slab, can be calculated. It is demonstrated that the precursory cooling can increase the wet front velocity by an order of magnitude. Existing experimental data with variable flow rates at atmospheric pressure are shown to be successfully correlated by the present model. (auth)

6837 RASMUSSEN ON REACTOR SAFETY. Rasmussen, N. C. (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Electr. Electron. Eng.) Spectrum; 12: No. 8, 46-55(Aug 1975).

A discussion is presented of the methodology employed in the reactor safety study which formed the basis of the WASH-1400 report. A brief discussion is also presented of risks outside the scope of the WASH-1400 report. These include hazards in shipping, waste disposal, sabotage, and theft of fissionable material. (DG)

6838 PRESENT STATUS OF THE SAFETY OF NUCLEAR POWER PLANTS WITH FAST GAS-COOLED REACTORS. Sharovarov, G. A. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 5-10(1974). (In Russian)

The modern situation of the problems of safety of the nuclear power stations with gas-cooled reactors is considered. 22 references. (auth)

6839 NUCLEAR DEBATE: RALPH NADER, REP. McCORMACK DISPUTE SAFETY ISSUES AT JOINT ENGINEERING LEGISLATIVE FORUM. Prof. Eng.; 45: No. 6, 23-30(Jun 1975).

Highlights of a debate by two leading figures on opposite sides of the nuclear question at the third annual Joint Engineering Legislative Forum in Washington are presented. (auth)

6840 WORLDWIDE NUCLEAR CONTROVERSY AND ITS IMPLICATIONS FOR LATIN AMERICA. Yulish, C. B. (Charles Yulish Associates, Inc., New York). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 11-12(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6841 ENVIRONMENTAL CONSIDERATIONS IN THE SITING, CONSTRUCTION, AND OPERATION OF A NUCLEAR POWER STATION. Chittenden, W. A. (Sargent and Lundy Engineers, Chicago). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 15(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6842 SEISMIC DESIGN CRITERIA FOR NUCLEAR POWER PLANTS. Guzman, R. (Fugro, Inc., Long Beach, CA). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 15-16(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6843 SYSTEMATIC REGIONAL APPROACH TO NUCLEAR POWER PLANT SITING. Smith, J. L.; Scott, J. D. (Fugro, Inc., Long Beach, CA). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 16-17(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6844 COMPUTER-ASSISTED SITE SELECTION. Halpern, J. A.; White, W. T. (Dames and Moore, Cranford, NJ). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 17-18(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6845 STUDIES, INVESTIGATIONS, AND PROBLEMS RELATED TO A 3200-MW(e) SITE. Kircher, E.; Dezordi, W. (FURNAS, Rio de Janeiro). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 18-19(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6846 SITING OF INDUSTRIAL ZONES NEAR CITIES. Skibin, D. (Nuclear Research Centre, Negev, Beer-Sheeva, Israel). Atmos. Environ.; 9: No. 5, 543-547(May 1975).

A theoretical treatment of the industrial siting problem is given. It is based on a simple general model intended to be used in the first stages of planning, for evaluation of existing conditions and for policy determining and decision making. The concept of "weighted rose" is presented and used, along with other criteria, to determine the best geometrical shape and sector for siting the industry. The method is applied to the city of Beer-Sheva. It is concluded that industry should be carefully sited according to proper meteorological measurement in order to prevent later harmful and costly effects. The presence of other nearby population centers could modify the picture and should be accounted for by the same method. Topography, land availability and cost, transportation systems, infra structure presence etc. could later be taken into account, preferably using a computer. (auth)

6847 ATOMIC INDUSTRIAL FORUM PUBLIC INFORMATION SEMINARS. Turner, P. (Atomic Industrial Forum, Inc., New York). Nucl. Technol.; 27: No. 1, 140-142(Sep 1975).

In a growing crisis situation, as government leaders strive to formulate and implement a workable long-term energy program, many experts agree that only coal and uranium are available to supplement our dwindling supplies of domestic oil and gas to make us independent of foreign sources of these fuels. At this critical time, the debate over nuclear power has shifted from the technological to the political arena, and the scientific community should recognize its responsibility to "break its silence" and should become involved in communicating the facts about nuclear power to decision makers and the general public. Independent scientists who do not recognize their responsibility to provide this guidance are doing a disservice to their discipline and to the broader areas of society it affects. By not speaking out on controversial subjects within their fields, scientists and technicians are assuming the risk that political and public policy will be established without the benefit of the full range of expert opinion. (auth)

6848 EUROPEAN PUBLIC INFORMATION ACTIVITIES. Gauvenet, A. J. (Commissariat a l'Energie Atomique, Paris). Nucl. Technol.; 27: No. 1, 154-160(Sep 1975).

The opposition to nuclear energy in Europe evolved along with some collective phenomena, such as the greater preoccupation toward environment, that began primarily in the U. S. Everywhere people are demanding more information and a greater participation in decision-making processes. Controversy is being strengthened by this trend toward "direct democracy"; this was particularly perceptible in centralized countries such as France, but was also apparent in such federal countries as Germany and Switzerland. Proper information cannot be easily dispensed in such an overheated atmosphere. The role of mass media has been and will be very important, but the media usually prefer broadcasting the alarming rather than the reassuring news. The credibility of information sources is a major point. State-owned utilities (in Britain or France) draw some benefit from their financial independence, although they are considered as responsible for decisions on nuclear projects. Atomic energy commissions and ministerial licensing or controlling bodies remain independent from the industrial companies. Scientific associations are not greatly developed in Europe although the situation is be-

ginning to change. Presently, it seems essential to rely on such intermediate bodies as physicians, politicians, and university professors to inform the man in the street. (auth)

6849 AMERICAN NUCLEAR SOCIETY PUBLIC INFORMATION ACTIVITIES. Witzig, W. F. (Pennsylvania State Univ., University Park). Nucl. Technol.; 27: No. 1, 161-165(Sep 1975).

The need for professional action to provide public information by each American Nuclear Society (ANS) member is based on our current domestic and international energy-related problems. Selected history of public information since the founding of the ANS through to its current activities provides a focus for future communication needs. Future efforts must be concentrated on key legislative groups, mass media, labor organizations, and local citizenry to convey an objective, well-rounded understanding of the benefits and risks of nuclear power. (auth)

6850 ENVIRONMENTAL ASPECTS OF BREEDERS. Cooper, R. D. (Energy Research and Development Administration, Washington, DC). Nucl. Technol.; 27: No. 1, 166-173(Sep 1975).

Since public understanding of the environmental consequences of new technologies is needed for informed decision-making, it is necessary to find a more effective alternative to the massive environmental statements that have been the result of pressure from the courts and from the opponents. A simplified conceptual framework for assessing the environmental impacts of a new energy system should include the benefits to be derived from the technology, the internal and external costs to man and to society, and a comparison with other alternatives. The first step in making such an analysis for breeder reactors is to define the need for a breeder system, the desired effects of the technology, and the probability of success and timing of the developments. The heart of the assessment is the estimation of the external costs including impacts on human health, on human environment, and on the social system. The final step is that of comparing the impacts of breeders with the impacts of alternatives and putting these into perspective with other risks and environmental costs for public understanding. (auth)

Reactor Theory and Calculation

Refer also to abstracts 6667 and 6772.

6851 (CONF-751101-30) LINEAR FILTERING APPLIED TO MONTE CARLO CRITICALITY CALCULATIONS. Morrison, G. W.; Pike, D. H.; Petrie, L. M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A significant improvement in the acceleration of the convergence of the eigenvalue computed by Monte Carlo techniques has been developed by applying linear filtering theory to Monte Carlo calculations for multiplying systems. A Kalman filter was applied to a KENO Monte Carlo calculation of an experimental critical system consisting of eight interacting units of fissile material. A comparison of the filter estimate and the Monte Carlo realization was made. The Kalman filter converged in five iterations to 0.9977. After 95 iterations, the average k-eff from the Monte Carlo calculation was 0.9981. This demonstrates that the Kalman filter has the potential of reducing the calculational effort of multiplying systems. Other examples and results are discussed. (auth)

6852 (EURFNR-1261) MANDI: A MANY-GROUP DIFFUSION AND P_1 CODE IN ONE SPACE DIMENSION. Stewart, H. B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Dec 1974. 68p. (KRK-2061). Dep. NTIS (US Sales Only) $5.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The program MANDI, a program for one-dimensional diffusion and P_1 calculations with a large number of energy groups, is presented. The code was written following a detailed study of discretization error for such problems, the results of which are reviewed. Separate sections document the numerical techniques in some detail and provide basic user's information about program options, input, and evaluated output. (auth)

6853 (ORNL-4938) KENO IV: AN IMPROVED MONTE CARLO CRITICALITY PROGRAM. Petrie, L. M.; Cross, N. F. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 213p. Dep. NTIS $7.60.

KENO IV is a multigroup Monte Carlo criticality program written for the IBM 360 computers. It executes rapidly and is flexibly dimensioned so the allowed size of a problem (i.e., the number of energy groups, number of geometry cards, etc., are arbitrary) is limited only by the total data storage required. The input data, with the exception of cross sections, fission spectra and albedos, may be entered in free form. The geometry input is quite simple to prepare and complicated three-dimensional systems can often be described with a minimum of effort. The results calculated by KENO IV include k-effective, lifetime and generation time, energy-dependent leakages and absorptions, energy- and region-dependent fluxes and region-dependent fission densities. Criticality searches can be made on unit dimensions or on the number of units in an array. A summary of the theory utilized by KENO IV, a section describing the logical program flow, a compilation of the error messages printed by the code and a comprehensive data guide for preparing input to the code are presented. 14 references. (auth)

6854 (ORNL-5062) VENTURE: A CODE BLOCK FOR SOLVING MULTIGROUP NEUTRONICS PROBLEMS APPLYING THE FINITE-DIFFERENCE DIFFUSION-THEORY APPROXIMATION TO NEUTRON TRANSPORT. Vondy, D. R.; Fowler, T. B.; Cunningham, G. W. (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. vp. Dep. NTIS $10.60.

The computer code block VENTURE, designed to solve multigroup neutronics problems with application of the finite-difference diffusion-theory approximation to neutron transport (or alternatively simple P_1) in up to three-dimensional geometry is described. A variety of types of problems may be solved: the usual eigenvalue problem, a direct criticality search on the buckling, on a reciprocal velocity absorber (prompt mode), or on nuclide concentrations, or an indirect criticality search on nuclide concentrations, or on dimensions. First-order perturbation analysis capability is available at the macroscopic cross section level. (auth)

6855 (ORNL-TM-4758) DEVELOPMENT AND APPLICATION OF A THREE-POINT INVERSE KINETICS ROD-DROP TECHNIQUE FOR SUBCRITICALITY DETERMINATION. Allen, J. W. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 90p. AT.

Thesis.

The subcritical reactivity of a reactor was determined by an Inverse Kinetics Rod-Drop (IKRD) method using a simple algorithm with error analyses involving statistical and parametrical uncertainties. The algorithm was developed to calculate reactivity, without using iteration procedures, from the observed neutron detector response using the point kinetics reactor model with a course. The algorithm can be incorporated into a computer on-line with a reactor to yield nearly instantaneous results. The algorithm included the following features (1) the statistical precision of the reactivity, (2) the sensitivity of reactivity to changes in the point kinetics parameters of effective delayed neutron group fractions and time constants, and (3) the uncertainty in reactivity due to uncertainties in the above parameters. An analysis of experimental problems was done including detector counting loss corrections, correction for detection efficiency changes and optimization of rod-drop dynamic range. The algorithm was successfully applied on both an on-line and off-line computer to count rate data from IKRD experiments with the engineering core mockup for the Fast Flux Test Facility reactor. The reactivity results agreed with those measured by other means and were obtained with statistical and parametrical uncertainties. The correction for detector counting loss and detection efficiency changes necessary for an accurate result in an on-line computer calculation were also successfully included in the algorithm for the IKRD experiments. (auth)

6856 (RT/FI-(75)5) STOCHASTIC KINETICS. 2. Detectrons. Colombino, A.; Mosiello, R.; Norelli, F.; Jorio, V. M.; Pacilio, N. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Mar 1975. 85p. (In Italian). Dep. NTIS (US Sales Only) $6.00.

Nuclear system kinetics according to a stochastic approach is analyzed. The detailed probability balance equations are written for the probability of finding the mixed population of neutrons and detected neutrons (detectrons) at a given level for a given instant of time. Equations are integrated in search of a probability profile: a series of cases is analyzed through a progressive criterium. It tends to take into account an increasing number of physical processes within the chosen model. The most important contribution is that solutions interpret analytically experimental conditions of equilibrium (noise analysis) and non-equilibrium (pulsed neutron measurements, source-drop technique, start-up procedures). (auth)

6857 USE OF THE ENERGY OF THE $^{10}B(n,\alpha)^7Li$ REACTION FOR RADIATION CHEMICAL PROCESSES IN SPECIAL

ZONES OF REACTORS. Krasin, A. K.; Kashcheev, V. P.; Litvinenko, B. A. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 11-14(1974). (In Russian)

Physical fundamentals for providing irradiation regions in a nuclear reactor where the $B^{10}(n,\alpha)Li^7$ reaction energy is used for carrying out radiation chemistry processes were determined. 7 references. (auth)

6858 RESIDUAL HEAT RELEASE IN REACTORS. Sharovarov, G. A.; Nichipor, V. V. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 18-24(1974). (In Russian)

Problems of residual heat are considered. The calculation methods and different factors effect on its value are analysed. 10 references. (auth)

6859 DETERMINATION OF THERMALIZATION PARAMETER M_2 AND NEUTRON TEMPERATURE IN WATER LATTICE BY PULSED SOURCE AND NON 1/v ABSORBER. Stanolov, A.; Hristov, V. (Inst. of Nuclear Research, Sofia). C. R. Acad. Bulg. Sci.; 28: No. 5, 605-608(1975).

Available experimental investigations of the nonstationary thermalization and spectral parameters in moderators, containing different kinds of heterogeneities, are quite insufficient for the determination of reliable reactor design data. An attempt is made to determine experimentally the neutron temperature and the thermalization parameter M_2—the mean square of energy transfer for one scattered thermal neutron, in cubic water lattices by means of a strong "non $1/v$" absorber of $CdCl_2 \times 2.5H_20$. It is known that there exists a mathematical similarity between the equations which describe the thermalized neutron pulse decay in a moderator with finite and infinite sizes with the addition of a variable concentration (N atoms/cm^3) of "non $1/v$" absorber. The experiments were carried out on the IRT-2000 reactor in Sofia by means of a fast chopper (6000 per/min, pulse length 160 μs and time interval between two pulses 5ms.). (9 references) (auth)

Reactor Components and Accessories

Refer also to abstracts 5928, 6013, 6041, and 6891.

6860 (ANL-CT-73-45824-3) SUMMARY OF TEST RESULTS FROM EXPERIMENT EX 49-70 FOR THE RSN-286, S/N M402 FISSION COUNTER-CHAMBER IN THE EBR-II NITF 0-1 THIMBLE AT 110°F AND SOME ANL TESTING OF THE SAME DETECTOR. Elsbergas, V. J.; Popper, G. F. (Argonne National Lab., Ill. (USA)). 14 Feb 1973. 46p. AT.

The test data taken on Reuter-Stokes fission counterchamber type RSN-286, S/N-M402 at ~110°F in the EBR-II NITF 0-1 thimble during Experiment EX 49-70, and the test data taken in a neutron source barrel and in the Argonaut reactor at ANL, Illinois to determine the counting, mean-square-voltage (MSV), and direct current neutron sensitivities with the Experiment EX 49-70 instruments are presented. No change in the detector's performance was indicated during the EBR-II experiment when compared to the characteristics determined at ANL, Illinois. (auth)

6861 (ANL-CT-76-9) VIBRATIONS OF CIRCULAR CYLINDRICAL SHELLS. Chung, H. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 51p. Dep. NTIS $5.50.

An exact solution method for the free vibration problem of thin circular cylindrical shells is presented. The differential equations of motion are solved directly with the use of simple Fourier series as the modal displacement functions. Stokes' transformation is exploited to obtain correct series expressions for the derivatives of the Fourier series. From this method an explicit expression of the exact frequency equation can be obtained for any kind of boundary conditions. The accuracy of the present method is checked against available data. The proposed method is then used to find the modal characteristics of the thermal liner of the Fast Test Reactor (FTR). The numerical results obtained are compared with finite element method solutions. (auth)

6862 (CONF-751036-1) TWO-PHASE FLOW VELOCITY MEASUREMENT USING RADIATION INTENSITY CORRELATION. Lassahn, G. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. 7p. Dep. NTIS $4.50.

From international standards association conference; Milwaukee, Wisconsin, USA (6 Oct 1975).

Flow velocities of two-phase fluids can be measured by transit time techniques using radiation beams as sensors to detect the passing of inhomogeneities. A Fourier spectrum analysis can be used as a kind of correlation or averaging technique to extract the velocity information from the signal-noise mixture. (auth)

6863 (ERDA-tr-52) STANDARDS FOR CALCULATING STRENGTH OF REACTOR COMPONENTS, STEAM GENERATORS, VESSELS, AND PIPING OF ATOMIC POWER STATIONS, TEST AND RESEARCH REACTORS, AND INSTALLATIONS. Oct 1975. Translation of Normy Rascheta na Prochnost' Elementov Reaktorov, Parogeneratorov, Sosudov i Truboprovodov Atomnykh Elektrostantsii, Opytnykh i Issledovatel'skikh Yadernykh Reaktorov i Ustanovok, Moscow, 1973. 308p. Dep. NTIS $7.60.

Information is presented which was compiled on the basis of Soviet and foreign theoretical and experimental investigations of the strength of the elements of atomic reactor vessels, steam generators, piping, fuel channels and other equipment with regard to the accumulated experience in design, manufacture, and operation. The recommended methods of calculating the stresses and displacements in the structural members and methods of determining the mechanical properties of the materials are presented in the appendices. The standards are compulsory for all agencies, design organizations, and enterprises which design, manufacture, and operate atomic power stations and nuclear reactors controlled by Gosgortekhnadzor of the USSR [state committee of the council of ministers for supervision of industrial safety and for mining inspection]. They may be useful to workers of all organizations engaged in manufacture and operation of pressure vessels. (auth)

6864 (INIS-mf-1544, pp 126-130) CALCULATION OF HELIUM ACCUMULATION IN REACTOR STRUCTURE MATERIALS FOLLOWING (n,α) REACTION ON INTERMEDIATE NEUTRONS. Balabanov, N. P.; Gledenev, Yu. M.; Popov, Yu. P.; Florek, M.; Furman, V. I. 1974. (In Russian).

From 2nd all-union conference on neutron physics; Obninsk, USSR (3 Mar 1974).

In neutron physics. Part 3. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.).

It is usually considered that intermediate-energy neutrons have no effect on the mechanical properties of materials. An analysis is made of the relative effect of the (n,α) reaction in the neutron energy range $0.5 \leq E_n \leq 10^6$ eV on radiation damage to reactor construction materials by accumulation of helium. The average alpha widths of the nucleus, interesting from the standpoint of reactor construction, were calculated from an optical model which satisfactorily describes experiments on (n,α) reactions. The contribution of neutrons of different energies and of neutron fluxes of different spectra in the accumulation of helium nuclei by the (n,α) reaction is considered. An analysis is presented which shows that calculation of the (n,α) reaction for intermediate neutrons is desirable in estimating the accumulation of helium in reactor construction materials. (tr-auth)

6865 (JPRS-66022) TURBINES FOR NUCLEAR POWER STATIONS. Translated from Teploenergetika; 22: No. 8, 2-12(1975). 29p. NTIS.

A description is presented of low speed turbines for nuclear power stations and of the PT-136.165-130.15 turbine with industrial and heating steam bleeders. (auth)

6866 (ORNL-RSIC-39) DEVELOPMENT OF RADIATION SHIELDING STANDARDS IN THE AMERICAN NUCLEAR SOCIETY. Trubey, D. K. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 11p. Dep. NTIS $4.00.

The American Nuclear Society (ANS) is a standards-writing organization-member of the American National Standards Institute (ANSI). The ANS Standards Committee has a subcommittee denoted ANS-6, Shielding, whose charge is to establish standards in connection with radiation protection and shielding, to provide shielding information to other standards writing groups, and to prepare recommended sets of shielding data and test problems. This paper is a progress report of this subcommittee. (auth)

6867 (SAND-75-5684) APPLICATION OF ELASTICITY THEORY AT SANDIA LABORATORIES. Davison, L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 10p. (CONF-750932-1). Dep. NTIS $4.00.

From annual meeting of the Society of Engineering Science; Austin, Texas, USA (21 Sep 1975).

Examples are given of the application of linear elasticity theory to the solution of practical problems encountered at Sandia Laboratories. It is being applied to a very broad range of problems: those in one, two, and three spatial dimensions, some involving static and some dynamic response, to materials having isotropic and anisotropic symmetry, to homogeneous and inhomogeneous bodies, etc. Various extensions of the theory to include electric,

magnetic and thermal effects, to account for material microstructure, for radiation and spall damage, chemical reactions, and other phenomena have been developed and/or applied. In some applications linear elasticity represents the physics of a problem well and is the theory of choice. In others the theory was used because it lent insight into a larger problem that was also attacked by means of other theories and/or experiment, and in some cases it serves as a part of a more encompassing theory. (auth)

6868 SELECTING THE PRESSURE OF INTERMEDIATE SUPERHEATING IN STEAM-TURBINE PLANTS WHICH OPERATE ON SATURATED STEAM. Sterman, L. S.; Tishin, S. G. (Moscow Order of Lenin Power Inst.). Izv. Vyssh. Ucheb. Zaved., Energ.; No. 3, 49-55(Mar 1975). (In Russian)

An analytical expression is derived for selecting the optimum separative pressure (pressure of intermediate superheating) in nuclear electric power plants operating on saturated steam. Calculations by the proposed method are compared with the results of computer calculations by the variant procedure done previously by the authors, and also with the results of other authors. The expression derived can be used to analyze the influence of individual thermodynamic and design parameters on the optimum separative pressure. The optimum pressure found by using the analytically established relation is approximated by a simple relation which can also be applied in choosing the separative pressure. (JPRS)

6869 ANALYTICAL CALCULATION OF REGENERATIVE COUNTERFLOW HEAT EXCHANGERS. Stepanchuk, V. F.; Shilo, A. F. (Belorussian Polytechnical Inst., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 54-59(1974). (In Russian)

Analytical expressions of temperature fields of gases and materials for counterflow regenerative heat exchanger in the common case, when periods of heating and cooling and water equivalents of hot and cold heat carriers are different are obtained. The formulas of the quantity of transformed heat and average temperature of heat carriers are given. (auth)

6870 ANALYSIS OF DRAIN PUMPING SYSTEM FOR NUCLEAR POWER PLANTS UNDER TRANSIENT TURBINE LOADS. Liao, G. S. (Bechtel Power Corp., Los Angeles). J. Eng. Power; 97: No. 4, 619-627(Oct 1975).

Many nuclear stations do not incorporate deaerators in their feedwater heating systems. To attain high turbine cycle performance without a deaerator, a drain pumping system is widely used for returning hot drains from the high-pressure heaters to the feedwater system. With a greatly increased feedwater flow for nuclear units, together with the drain pumping system being moved to a higher extraction point, the heater–drain tank system will be subject to a rapid pressure decay under turbine load rejections. In addition, the drain pump suction flow reduces considerably, thereby increasing the suction pipe resident time. It is these critical changes in operating conditions that should receive careful consideration in drain pumping system design. An analytical approach is presented for determining drain tank pressure decay, drain pump suction pressure decay, and transient behavior of the heater–drain tank system based on analysis of closed feedwater heater performance and the varying feedwater temperature entering the heater under turbine load rejections. The emphasis is placed on adequate and optimum design of a drain pumping system, including a discussion of some design criteria to be followed, as well as sizing of the pressure equalizer between heater and drain tank. All mathematical equations required for determining the design parameters are derived. Finally, some example calculations are given to illustrate the application of the developed analytical approach to system design. (auth)

6871 DETERMINATION OF THE OPTIMUM CONFIGURATION OF THE REACTOR CORES MADE UP OF SPHERICAL MICROFUEL ELEMENTS. Pobedrya, A. E.; Khorev, V. I. (Inst. of Nuclear Power Engineering, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 25-30(1974). (In Russian)

Optimization of the form for the fixed-bed reactor core is considered taking into consideration both thermo-hydraulic calculation and some demands of physical calculation. In order to improve the balance of neutrons the variational problem has been solved to determine bodies of revolution having the least ratio surface to volume. The computational method of optimum core configuration is suggested. 11 references. (auth)

6872 STATE-OF-THE-ART REVIEW OF NONDESTRUCTIVE TESTING AS APPLIED TO NUCLEAR PRESSURE VESSELS AND COMPONENTS. Forrer, G. R. (G. R. Forrer Associates, Barberton, OH); Sattler, F. J. Mater. Eval.; 33: No. 10, 20A-24A(Oct 1975).

From meeting on nondestructive testing in nuclear power industry; Columbus, OH, USA (23 Sep 1974).

The state-of-the-art of nondestructive examination (NDE) is the result of the efforts of many different technical societies. As applied in the commercial nuclear industry under the ASME B and PV Code, NDE has been shaped by ASME, ASTM, and ASNT inputs. This paper discusses the interrelationships of the societies, the development of the NDE requirements for the commercial nuclear industry, and the state of NDE technology for both fabrication and inservice examinations. (auth)

Reactor Fuels

Refer also to abstract 6820.

6873 (CONF-751016-3) ACOUSTIC EMISSION FROM THERMAL-GRADIENT CRACKS IN UO_2. Kennedy, C. R.; Kupperman, D. S.; Wrona, B. J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 23p. Dep. NTIS $4.50.

From conference of the American Society for Nondestructive Testing, Inc.; Atlanta, Georgia, USA (13 Oct 1975).

A feasibility study has been conducted to evaluate the potential use of acoustic emission to monitor thermal-shock damage in direct electrical heating of UO_2 pellets. In the apparatus used for the present tests, two acoustic-emission sensors were placed on extensions of the upper and lower electrical feedthroughs. Commercially available equipment was used to accumulate acoustic-emission data. The accumulation of events displayed on a cathode-ray-tube screen indicates the total number of acoustic-emission events at a particular location within the pellet stack. These tests have indicated that acoustic emission can be used to monitor thermal-shock damage in UO_2 pellets subjected to direct-electrical heating. 8 references. (auth)

6874 (CONF-751113-7) EXPERIMENTAL DESIGN FOR HTGR FUEL RODS. Bayne, C. K. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 12p. Dep. NTIS $4.50.

From 1st ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

Fuel rods for the high temperature gas cooled reactor are composed of pyrolytic carbon coated fuel particles bounded by a carbonaceous matrix. Because of differential shrinkage between coated particles and the carbonaceous matrix, breakage of the pyrolytic coating has been observed with certain combinations of coated particles and matrix compositions. The pyrolytic coating is intended to be the primary containment for fission products. Therefore, an experiment is desired to determine the breakage characteristics of different strength coated particles combined with different matrix compositions during irradiation. (auth)

6875 MANUFACTURING EXPERIENCE IN THE UNITED STATES FOR LIGHT-WATER REACTOR FUEL. Lingafelter, J. W. (Nuclear Services Corp., Campbell, CA). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 44-45(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

6876 NUCLEAR FUEL MANUFACTURE IN MEXICO. Ocon, C. V.; de la Tijera, J. S.; Morillo, H. G. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 45-47(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Reactor Control Systems

6877 (CONF-750303-78) INTEGRAL CAPTURE CROSS-SECTION MEASUREMENTS IN THE CFRMF FOR LMFBR CONTROL MATERIALS. Anderl, R. A.; Harker, Y. D.; Turk, E. H.; Nisle, R. G.; Berreth, J. R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). 1975. 4p. Dep. NTIS $4.50.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Integral capture-cross sections for separated isotopes of Eu and Ta are reported for measurements in the Coupled Fast Reactivity Measurements Facility (CFRMF). These cross sections along with that measured in the CFRMF for ^{10}B(n,alpha) provide an absolute standard for evaluating the relative reactivity worth of Eu_2O_3, B_4C and Ta in neutron fields typical of an LMFBR core. Based on these measurements and for neutron fields characterized by the ^{235}U:^{252}U reaction rate spectral index ranging from 23 to 50, the infinitely dilute relative worth of Eu_2O_3 has been estimated to be 25 percent to 40 percent higher than that for B_4C and 80 percent to 100 percent higher than that for Ta. 11 references. (auth)

Nuclear Power Plant Economics

Refer also to abstract 5091.

6878 TODAY'S NUCLEAR CHALLENGE: MAINTENANCE AND RADIATION EXPOSURE. Willis, C. A. (International Atomic Energy Agency, Seoul). J. Korean Nucl. Soc.; 7: No. 2, 159-165(Jun 1975).

The nuclear power industry today faces a serious and rapidly emerging problem in reactor maintenance and occupational radiation exposure control. The basic problem is the need for much maintenance on nuclear power plants. The problem is seriously compounded by radiation exposure control requirements. Many studies are underway seeking solutions but the industry is developing rapidly and new plants will not await the results of such studies. It is essential that attention be given to maintenance and exposure control in all phases of plant design, construction and operation. (auth)

6879 POTENTIAL ROLE OF NUCLEAR POWER IN DEVELOPING COUNTRIES. Cartwright, P. (General Electric Co., San Jose, CA). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 3-4(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6880 ROLE OF NUCLEAR ENERGY IN MEETING FUTURE POWER NEEDS IN MEXICO. Eibenschutz, J. (Comision Federal de Electricidad, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 4-5(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6881 INTEGRATING NUCLEAR INDUSTRY INTO DEVELOPING COUNTRIES. Jones, C. F. (NUS Corp., Rockville, MD). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 6-8(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6882 NUCLEAR POWER AND NATIONAL PARTICIPATION IN MEXICO. Sefchovich, E. (Comision Federal de Electricidad, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 8-9(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6883 PLANNING THE PREPARATION AND AVAILABILITY OF MANPOWER FOR THE NUCLEAR INDUSTRY. Spitalnik, J. Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 10-11(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

Reactor Fuel Cycle Economics

Refer also to abstract 5107.

6884 PARTICIPATION OF URANIUM IN THE ELECTRIFICATION OF MEXICO. Galvez, L.; Lartigue, J. (Instituto Nacional de Energia Nuclear, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 5(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6885 REACTOR STRATEGY STUDIES FOR BRAZIL. Oosterkamp, W. J.; Hukai, R. Y.; Pieroni, R. R. (Instituto de Energia Atomica, Sao Paulo, Brazil). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 25-26(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6886 ECONOMIC ANALYSIS OF NUCLEAR FUEL CYCLES. Lartigue, J. (Instituto Nacional de Energia Nuclear, Mexico City); Ortega, R. F. Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 39-40(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

6887 PLUTONIUM UTILIZATION AND OPTIMUM FUEL CYCLES FOR LATIN AMERICA. Puechl, K. H. (Nuclear Consultant, Atlanta). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 42-43(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928.

Reactor Licensing and Regulation

6888 (EUR-5362e) CATALOGUE AND CLASSIFICATION OF TECHNICAL SAFETY RULES FOR LIGHT-WATER REACTORS AND REPROCESSING PLANTS. Bloser, M.; Fichtner, N.; Neider, R. (Commission of the European Communities, Brussels (Belgium)). 1975. 441p. Dep. NTIS (US Sales Only) $12.75. EUR FB 800,-.

A list of classified standards is presented for landbased light-water reactors and reprocessing plants. The reasons for the classification system used are given and discussed. (auth)

6889 (NP-tr-1956) TRANSLATIONS: SAFETY CODES AND GUIDES. 25 Jun 1974. Translation of German Report. 20p. Dep. NTIS (US Sales Only) $4.50.

These nuclear power plant safety criteria were prepared as the technical part of a future General Administrative Regulation. They were approved by the Länder Committee for Nuclear Energy on June 25th 1974 after the groups of experts participating in the licensing procedure, mainly the manufacturers and construction companies, utilities and consultants had the opportunity to express their opinions. The safety criteria are published in order to give the opportunity of applying the requirements contained therein as early as possible. (auth)

6890 (NRCI-75/9) NUCLEAR REGULATORY COMMISSION ISSUANCES, SEPTEMBER 1975. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Nov 1975. 265p. TIC $4.00.

Issuances received from the U.S. Nuclear Regulatory Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

6891 (RDT-P-2-5T(Rev.)(10-75)) MEDIUM VOLTAGE SWITCHGEAR. (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Oct 1975. 13p. RSO.

This standard establishes the requirements for the design, fabrication, testing and quality assurance for medium voltage switchgear up to 15 kV ratings for nuclear reactors. Compliance with ANSI C37 forms part of the requirements of this standard. Plant Protection System (PPS) undervoltage sensing devices are not covered by this standard. (auth)

6892 (REG/G-1.102(10-75)) FLOOD PROTECTION FOR NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Oct 1975. 4p. NUREG.

6893 (REG/G-1.105(11-75)) INSTRUMENT SPANS AND SETPOINTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Nov 1975. 2p. NUREG.

A method acceptable to the NRC staff for complying with the Commission's regulations with regard to ensuring that instrument setpoints initially are within and remain within the specified safety system setting is presented. (auth)

6894 (REG/G-1.107) QUALIFICATIONS FOR CEMENT ROUTING FOR PRESTRESSING TENDONS IN CONTAINMENT STRUCTURES. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Nov 1975. 6p. NUREG.

This guide describes quality standards acceptable to the NRC staff for the use of portland cement grout as the corrosion inhibitor for prestressing tendons in prestressed concrete containment structures. (auth)

6895 (REG/G-4.7(Rev.1)) GENERAL SITE SUITABILITY CRITERIA FOR NUCLEAR POWER STATIONS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Nov 1975. 32p. NUREG.

Considerations for assessing site suitability for nuclear power plants are presented under the following headings: geology/seismology; atmospheric extremes and dispersion; population considerations; hydrology; ecological systems and biota; land use and aesthetics; industrial, military, and transportation facilities; socioeconomics; and noise. (JWR)

6896 U.S. NUCLEAR STANDARDS PROGRAM: A STATUS REPORT. Prestele, J. A. (Consolidated Edison Co. of New York, Inc., New York). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 13(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

6897 PROPOSED MODIFICATIONS TO 10CFR50, APPENDIX B, FOR APPLICATION TO MEXICAN NUCLEAR POWER PROJECTS. Rivera, R. B. (Comision Federal de Electricidad, Mexico City). Trans. Am. Nucl. Soc., Suppl.; 21: No. 2, Suppl., 13-14(1975).

From nuclear power and applications in Latin America; Mexico City, Mexico (28 Sep 1975). See CONF-750928-.

GENERAL AND MISCELLANEOUS

Information Handling

Refer also to abstracts 5589 and 6588.

Management

6898 SUMMER WORKSHOPS FOR HIGH-SCHOOL SCIENCE TEACHERS. Young, H. H. (Energy Research and Development Administration, Washington, DC); Kohl, J. Nucl. Technol.; 27: No. 1, 148-153(Sep 1975).

A total of 52 summer workshops attended by over 1700 high-school science teachers have been given by 27 universities in the period of 1971 to 1974. These workshops are funded by ERDA to provide factual material through educational channels so that the public could obtain an informed perspective of the role of nuclear energy as an electrical power source. The workshops have included lectures, panel discussions, laboratories, and field trips, and have emphasized providing teachers with materials for use in their classrooms. Actual use of workshop material has been monitored through workshop reports, meetings, and visits. Participants have used their workshop experience for classroom presentations, talks to the public, and for assembly programs. The material developed and the experience of presenting it has proved valuable for the nuclear engineering faculty members giving the workshops. They have used their experience in other courses, for public lectures, and for other workshops. And they have gained personal experience in methods of dealing with the nuclear power controversy. A review of these workshops indicates that they offer at a reasonable cost a productive method of presenting factual information on the various solutions to the complex electrical generation problem. (auth)

Mathematics and Computers

Refer also to abstracts 5592, 5593, 5645, 5822–5842, 5844, 5845, 5847, 5848, and 6006.

6899 (CONF-751113-3) RANDOM MATRICES AND RANDOM DIFFERENCE EQUATIONS. Uppuluri, V. R. R. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 24p. Dep. NTIS $4.50.

From 1st ERDA statistical symposium; Los Alamos, New Mexico, USA (3 Nov 1975).

Mathematical models leading to products of random matrices and random difference equations are discussed. A one-compartment model with random behavior is introduced, and it is shown how the average concentration in the discrete time model converges to the exponential function. This is of relevance to understanding how radioactivity gets trapped in bone structure in blood–bone systems. The ideas are then generalized to two-compartment models and mammillary systems, where products of random matrices appear in a natural way. The appearance of products of random matrices in applications in demography and control theory is considered. Then random sequences motivated from the following problems are studied: constant pulsing and random decay models, random pulsing and constant decay models, and random pulsing and random decay models. (RWR)

6900 (UCCND-CSD-18) MATHEMATICS AND STATISTICS RESEARCH DEPARTMENT PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1975. Coveyou, R. R.; Gosslee, D. G.; Wilson, D. G. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1975. Contract W-7405-eng-26. 73p. Dep. NTIS $5.45.

Brief reports on mathematical and statistical research and consulting and collaboration are given for the following areas: statistical estimation, statistical testing, experimental design, probability, energy systems modeling, continuum mechanics, matrices and other operators, numerical analysis, biomathematics and biostatistics, analytical chemistry, biology and medicine, health physics research, management, materials research, physics research, and programming. Information on seminars, publications, etc., is also included. (10 figures, 4 tables) (RWR)

6901 (UCRL-51829) FAULT TREES FOR DECISION MAKING IN SYSTEMS ANALYSIS. Lambert, H. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Oct 1975. Contract W-7405-Eng-48. 351p. Dep. NTIS $10.60.

Thesis.

The application of fault tree analysis (FTA) to system safety and reliability is presented within the framework of system safety analysis. The concepts and techniques involved in manual and automated fault tree construction are described and their differences noted. The theory of mathematical reliability pertinent to FTA is presented with emphasis on engineering applications. An outline of the quantitative reliability techniques of the Reactor Safety Study is given. Concepts of probabilistic importance are presented within the fault tree framework and applied to the areas of system design, diagnosis and simulation. The computer code IMPORTANCE ranks basic events and cut sets according to a sensitivity analysis. A useful feature of the IMPORTANCE code is that it can accept relative failure data as input. The output of the IMPORTANCE code can assist an analyst in finding weaknesses in system design and operation, suggest the most optimal course of system upgrade, and determine the optimal location of sensors within a system. A general simulation model of system failure in terms of fault tree logic is described. The model is intended for efficient diagnosis of the causes of system failure in the event of a system breakdown. It can also be used to assist an operator in making decisions under a time constraint regarding the future course of operations. The model is well suited for computer implementation. New results incorporated in the simulation model include an algorithm to generate repair checklists on the basis of fault tree logic and a one-step-ahead optimization procedure that minimizes the expected time to diagnose system failure. (80 figures, 20 tables) (auth)

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